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# The Use of Barite in Soda Lime Flint Glasses

## Constant Increase in Use of Barytes, the Natural Sulphate of Barium, During Past 18 Months

By D. J. McSwiney[1]

Barium oxide has long been used as a constituent of special glasses and of table ware so that its fluxing power and its effect on the different properties of glass are well known. The barium oxide has been almost entirely introduced into glass batches in the form of the carbonate—mostly as the mineral witherite; other barium compounds have been suggested as glass making materials or used to a limited extent; for example, the peroxide has been suggested as a substitute for arsenic and the sulphate has been used in a number of foreign batches, especially old batches melted in pots.

Barite (or barytes) the natural sulphate of barium is by far the cheapest source of barium oxide; it is a mineral of wide distribution in nature. Although, as stated, its use in foreign batches is old, until recently little or no attention has been paid in this country to the possibilities of its use in colorless soda lime glasses.

The chief objections raised against the use of barytes in such glasses is the belief that in order to render effective as glass forming materials any of the sulphates of the alkali or alkaline earth metals, reducing materials must be added to the batch, and the fact that barite from most sources is too high in iron content to allow its use in any quantity in colorless glasses.

During the past eighteen months, largely through the efforts of a company exploiting the use of barytes in a mystery mixture sold under a fancy name and at a corresponding price, a large amount of barytes has been used in flint glass, and the amount used is constantly increasing; the writer is informed by an authoritative source that the amount of barite at present being used in flint glass in this country is about 500 tons per month. The greater part of this amount is being used with good results by a number of companies manufacturing glass containers. A fair amount has been used by manufacturers of different types of flat glasses and while the results obtained with such glasses are not conclusive they are promising enough to warrant further investigation along this line.

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As stated above, the belief has been rather general that the use of any considerable amount of barite in glass batches, required the addition of carbon to render the barium oxide available; for example, Dralle states that the addition of barytes to glass batches without the use of a corresponding amount of carbon, tends to give scum. This is true to some extent when large amounts of barytes are used in glass batches; however, when small or moderate amounts of this material are used, the opposite is the case; in such amounts barytes tends to act as a scum preventative, and is not infrequently used for that purpose.

The amounts of barytes being used at present in batches in this country is from 25 lbs. to 100 lbs. per ton of sand—in most cases about 60 lbs.; this is equivalent to approximately 1.2 per cent barium oxide in the glass. The claims made for the use of barytes in soda lime glasses are, that it gives an easier melting batch; that the glass refines more rapidly; that it increases the brilliancy of the ware; and that it improves the annealing and working properties of the glass and its resistance to weathering. These claims are in part based on what is known of the properties of glasses of higher barium content, although the results obtained would tend to substantiate these claims to some extent.

Aside from lead oxide, barium oxide is the only cheap basic oxide which approaches the alkalies in fluxing power; the barium glasses, moreover, are very fluid at soda lime glass melting temperatures, and it is probably on this property that the use of barium sulphate as a scum preventative depends. It would appear that amounts of barium oxide of the order of one per cent should not have a very marked effect on the temperature at which the glass can be melted, refined and worked, but most users of barytes claim to be working their tanks at a lower temperature than before barytes was used. Claims of reduction in temperature vary from 50 deg. F. to 200 deg., averaging about 75-100 deg. In any case, the introduction of such amounts of barytes has an apparent influence on the way piles of some batches melt down in tanks; such batches with barytes show

the vigorous fluxing action which used to be characteristic of batches containing considerable nitre.

As barium glasses have a high index of refraction, barium oxide being second only to lead in increasing the refractive index, barium compounds have long been suggested and used in those glasses where brilliancy of the ware is of great importance and where the use of lead is undesirable because of its higher price, its tendency to blacken, etc. While, again, it would appear that the effect of one per cent of barium oxide on the refractive index would not be sufficient to cause any great increase in the brilliancy of the glass, there is no doubt that the use of this material has improved this property of the glass in many cases, and that the appearance of glasses made with barytes batches has been, on the whole, quite good.

It is probable that the apparent increase in brilliancy from the use of barytes results less from an increase in refractive index than from the oxidizing effect which the barytes exerts during the melting—in which case, it probably acts like arsenic or nitre on a selenium color, tending to prevent the development of a yellowish or brownish cast, and possibly to an increase in the fluidity of the glass tending to smooth out any irregularities of the surface caused by the use of rough molds.

The effect of the addition of barytes on the working properties of the glass seems to vary with different batches and with the type of ware made; in some cases, better and quicker operation is claimed, while with other ware, particularly with heavy ware and glasses of low alumina content, and the usual ratio of soda, lime and silica, the addition of barytes has necessitated some modification of blanks or has slowed operation slightly. Barytes appears to work well in those batches containing alumina, added as feldspar or in some other form, tending as it does to offset the action of alumina in increasing the viscosity of the glass at the refining and working temperatures.

The use of barytes in the batch in the above quantities does not appear to exert any pronounced effect on the annealing temperature or the resistance to weathering. Judging from the work done on glasses of high barium content, the addition of barytes should tend to lower the annealing temperature somewhat. The effect on the resistance to weathering will depend on what changes are made in the base batch on the addition of the barytes; if this addition is made at the expense of the silica, as is usually the case, a slight decrease—probably not enough to be noticeable—should be expected in the weathering resistance; while if the addition is made largely at the expense of the soda, an increase in this resistance should result, but not enough to counterbalance the loss of the favorable effect which the barytes otherwise would have on the melting and refining. While high barium glasses usually show a tendency to devitrify greater than that shown by soda lime glasses, the amounts of barytes at present used are insufficient to have any undesirable effect in this respect.

Some trouble has occurred on introducing barytes into batches as a result of the use of material of too high an iron content, or from failure to adjust the amounts of selenium and cobalt used for decolorization; the use of barytes requires a slight increase in the amount of selenium used—acting like arsenic in this respect—so that the ratio of selenium to cobalt used for decolorization should be increased on the addition of barytes, otherwise the glass may develop a bluish cast. Cords also result from the use of barytes if this material is used in too coarse a form or if the mixing of the batch is insufficient.

The barytes at present used in flint glass sells from $15.00 to $25.00 per ton; some of it is much too high in iron content to be used safely even in small quantities unless the iron content of the other batch materials is very low, but some sources have been developed the barytes from which is sufficiently low in iron to be used safely with any materials at present being used for flint glass.

While further investigation is needed to decide whether or not the use of barytes has advantages sufficient to recommend its use in flat soda lime glasses, it has been used in blown ware for such a period and in such quantities as to suggest that, like alumina materials, its addition to soda lime glasses will probably become a standard practice in this country.

## Society of Glass Technology

President Walter Butterworth, Sr., presided at the meeting of the Society of Glass Technology held in Leeds on March 21, 1928. Two papers were presented and discussed.

(a) A METHOD FOR THE DETERMINATION OF THE PROBABLE DURABILITY OF TANK BLOCKS, by E. J. Bowmaker. Two methods were described.

(1) The specimen was ground to a smooth surface (the edges were bevelled), dried and weighed. After three hours boiling in an acid mixture (3 HF: $2H_2SO_4$), the test piece was transferred to sulphuric acid, boiled, dried and reweighed. The percentage loss in weight was a measure of the attack on the block, the lowest values being obtained for good blocks.

(2) The ground weighed specimen was treated with the acid mixture as in (1), the boiling with sulphuric acid was omitted, and the test piece was ignited strongly in a crucible.

The lecturer suggested that a combination of methods (1) and (2) would probably yield the most satisfactory agreement between test and works practice, and such a modified method would be tried. The results obtained in some of his tests were closely parallel to the behavior of the blocks tested when used in the glass tank.

(b) THE STUDY OF A FUNDAMENTAL REACTION IN GLASS MAKING. By J. T. Howarth, M. Sc., and Prof. W. E. S. Turner.

The reaction between silica and sodium carbonate was studied in two ways, namely, (1) by determining the decomposition pressures over a range of temperature up to about 800 degrees C. (2) by time-temperature experiments in open crucibles. A special apparatus of fused quartz was designed for the decomposition pressure determinations and it was used also for the measurement of the dissociation pressure of sodium carbonate up to 1000 degrees. At this temperature the dissociation pressure was 20 m.m.

Mixtures of pure quartz ground to 100-150 mesh and sodium carbonate (200 mesh) were made in the molecular proportions $Na_2CO_3$ 4 $SiO_2$; $NaCO_3$ $SiO_2$; $Na_2CO_3$ ½ $SiO_2$. There was indication of reaction in such mixtures at temperatures approximately 270 to 350 degrees. In the detailed study of the mixture $Na_2CO_3$ 4 $SiO_2$ it was found that the reaction could be made to proceed to completion, in a few hours at 700 degrees, in about 330 hours at 600 degrees and in several weeks at 500 degrees.

# A Unique Lehr

## Actual Fuelless Accomplishment

### Provides Remarkable Distributing Device

### H. L. Dixon Becomes Actively Interested in Recent Invention

**Just a year ago there appeared in this journal an exclusive, illustrated description of a lehr designed on radically different principles from those in use,—built and installed by the Thermal Engineering Company, Fairmont, West Virginia, in the factory of the Peerless Glass Company at Long Island City, New York, where, in November, 1926, a machine was started, annealing bottles. It continued in exceptionally successful production through the winter, spring and summer until the end of the fire in August, 1927. In the fall of 1927 the fires were again started and since then the same lehr has been producing uninterruptedly. Three new lehrs in the same plant and constructed on the same principles were put in operation in December, 1927, and have been running continuously since that time.**

**The results shown by this large scale commercial demonstration, in cost reduction, production increase, and quality of ware, became known to many in the trade and made a deep impression on the majority of those who were familiar with the operations going on.**

**This type of lehr is now available to the trade in general. It has been planned that the Thermal Engineering Company will continue to fabricate the lehrs in the modern plant it owns in Fairmont, recently equipped with the necessary machinery for manufacturing on a substantial scale, all of it being of new and modern type, and will install the lehrs they build in the plants to which they are sold. All of these operations will be in charge of John Mayo and H. L. Dixon, president, for years beyond recollection, of the H. L. Dixon Company.**

**The name "Dixon Auto-Thermal Lehr" has been adopted to distinguish the machine from those of other manufacturers. The title is indicative of its character, the machine, it is claimed, being the first practical, comprehensive, complete commercial application of the fireless principle to annealing apparatus. It is also completely automatic in operation including the distributor or stacker and said to be under perfect thermal control, a statement substantiated by over a year's successful commercial operation.**

**In view of the wide-spread interest with which this news will be received throughout the glassware industry, both in this and foreign countries where the Dixon organization is well known, this appears to be an appropriate occasion for publishing a fresh description and new illustrations of the lehr as now constructed, with perhaps some brief repetition from the earlier article, in order to bring the story of the unusual achievement up to the present stage.**

AN outstanding characteristic of the Dixon Auto-Thermal Lehr, that is evident to all who have observed its operations at the plant where it was developed, is its extreme mechanical simplicity. The roller conveyor is an example, and the absolutely unique device that stacks or distributes the ware in the lehr, may justly be classed as one of the most simple, efficient and interesting pieces of machinery yet devised for performing an essential operation in the glassmaking process. The simple principle on which the ware distributor operates had been overlooked for years, but at last it has become the means of overcoming an operating situation that ever since the advent of automatic machinery has baffled the best of glass men.

This particular part of the lehr works impressively, like an automaton with seeming intelligence, locating the ware on the conveyor rollers exactly where it should be.

The movement of the ushers that comprise the distributing device consume no power whatever, the only force exerted on them being the slight pressure transmitted by the moving bottles themselves. Observing the device in operation and having had ocular proof that it has solved one of the serious problems of glassmaking, one feels that here is seen the triumph of simplicity.

The new conveyor and distributor eliminates from the annealing process the last manual operation still existing—that of the carry-in boy, on any kind of glass article, some of which, however, may require owing to their shapes, a little special attention.

### The Fireless Feature

Another striking feature emphasized by the proponents of the invention is the fact that the annealing operation, after the first heating up of the annealing zone for the Monday morning start (at a cost of less than a dollar for fuel) preliminary to sending through the ware from the machine, is an absolutely fuelless one. Where the lehr is used continuously, there is practically no upkeep cost aside from a negligible amount of driving power and a little lubricant for the roller bearings, the time consumed in applying the latter being very short as the bearings are on the outside of the lehr under easily removable guards which also protect the sprocket wheels and chains that drive the conveyor rollers. All parts are very accessible.

Perfect thermal control, it is claimed, has been definitely established over a period of eighteen months, and the claim of perfect heat conservation and graduation is supported by the fact that no imperfectly annealed ware is produced nor broken ware as the remarkable distributing mechanism places each piece in its proper position with fixed spaces between it and the next pieces, therefore, there can be no sticking. A push-up mechanism lifts the ware up to the roller conveyor between machine and lehr entrance and is designed to meet different conditions, such as height of ware, in delivering from machine to lehr.

Each lehr in the Peerless plant is equipped with a Wilson-Maeulen indicating pyrometer by which the temperature at any of the ten points along the chamber, where the Pyod thermocouples are placed, may quickly be read. In the superintendent's office a Wilson-Maeulen pyrometer registers separately on the chart all the heat variations that occur in any one of the four lehrs.

Provision is made for maintaining the heat in lehr at any desired temperature during the week-end shut-downs.

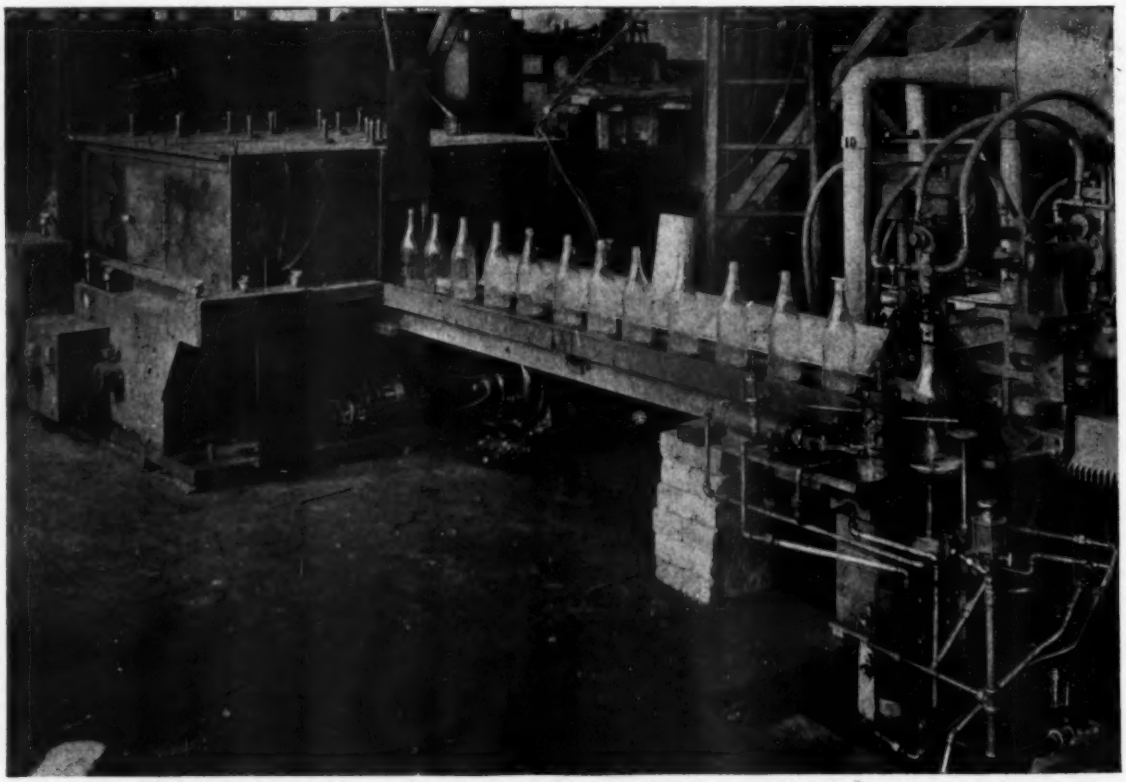

FIG. 1. LYNCH MACHINE TAKE-OUT DEPOSITING BOTTLE ON PUSH-UP ELEVATOR, WHICH AUTOMATICALLY RAISES IT TO LEVEL OF ROLLER CONVEYOR ON TO WHICH IT IS TRANSFERRED BY THE AUTOMATIC WIPER. THE CONVEYOR DELIVERS IT TO THE STACKER JUST INSIDE THE LEHR ENTRANCE

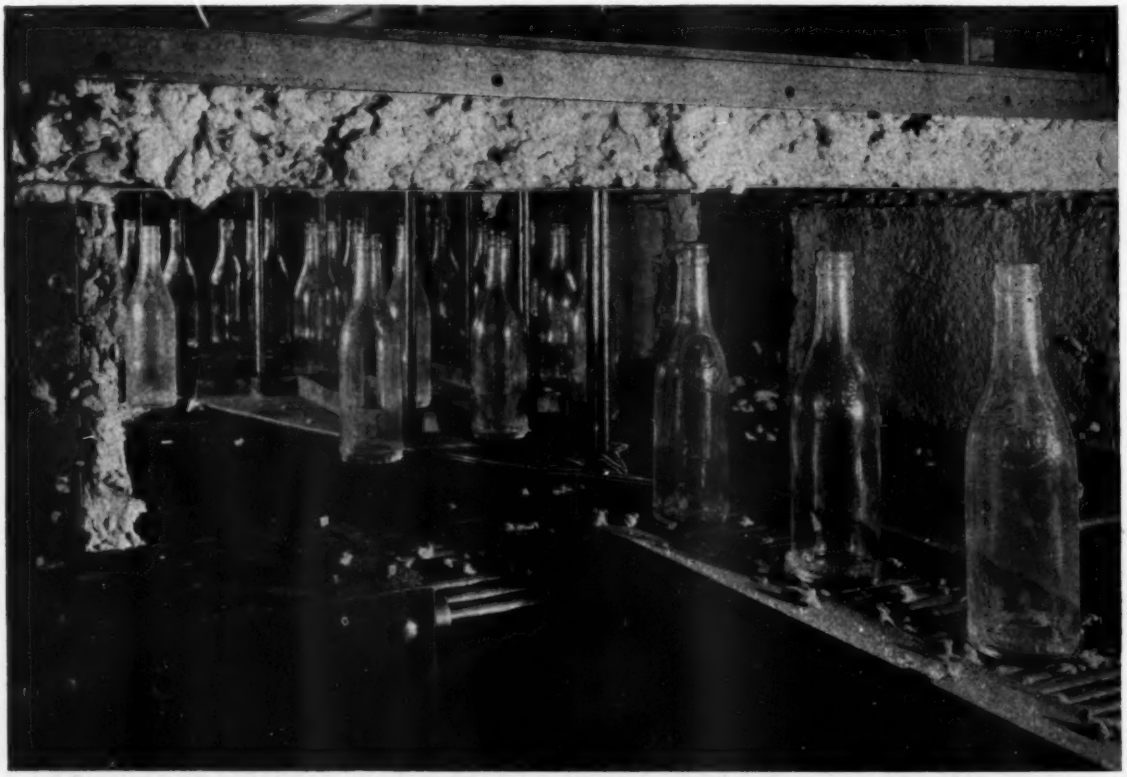

FIG. 2. FRONT WALL OF LEHR REMOVED EXPOSING AUTOMATIC DISTRIBUTING OR STACKER SYSTEM. BY MEANS OF USHERS SUSPENDED AT THE PROPER POINTS, THE HOT BOTTLES ARE KEPT SEPARATE FROM EACH OTHER AND GUIDED INTO EITHER STRAIGHT OR STAGGERED ROWS.

An electric heating element if desired may be provided as a means for preliminary heating when necessary, thus doing away with gas lines and troublesome connections. This may also to be used for decorating purposes.

Towards the outer end of the cooling section of the lehr, a small fan is placed for use in equalizing the temperatures when it is desired to cool the ware faster or to hold the hot air longer in the front part. It is only on a closed front lehr that this device can be successfully applied.

With no conveyor, pans or chains traveling through the lehr to absorb and dispel the heat, as it enters and leaves the chamber, the most efficient conservation of the heat is effected and the cost of fuel is nil—none being used, for the ware entering at uniform intervals on the automatic conveyor from the machine still retains sufficient heat to successfully accomplish their own annealing through as long a run as desired, even many months, without fuel. Very small articles may require some additional heat or a specially built lehr. It has been shown that seven-ounce ware will carry enough heat for annealing in a 15-inch chamber.

The whole annealing operation is entirely automatic from shear-cuts to the packer, requiring no boys, no tools, and, best of all, no labor. The man operating the blowing machine can give the lehr all the slight attention needed. Week after week, like a railroad tunnel, it receives and discharges "without a whimper."

It is believed, therefore, that with both fuel consumption and labor costs reduced to zero, it will be impossible for any future invention to reduce costs of the two items just mentioned, which have already been brought down by this improved lehr to the vanishing point; and that the necessity for frequent scrapping of lehrs with every change in heating or handling equipment will disappear.

### Construction Details

The principal constructional details of the machine are clearly shown in the accompanying pictures.

The ware passes along at fixed speeds on a system of rollers, driven on both sides of the lehr by means of small sprockets and sprocket chains giving it a constantly changing bottom contact and requiring no more than a 2 h.p. motor. The operation of this motor and a small 1 h.p. for the fan, and an occasional lubricant is all the expense involved unless the lehr should be stopped; then a little preheating is necessary to warm up the heat zone until the hot ware reaches it after the resumption of operations.

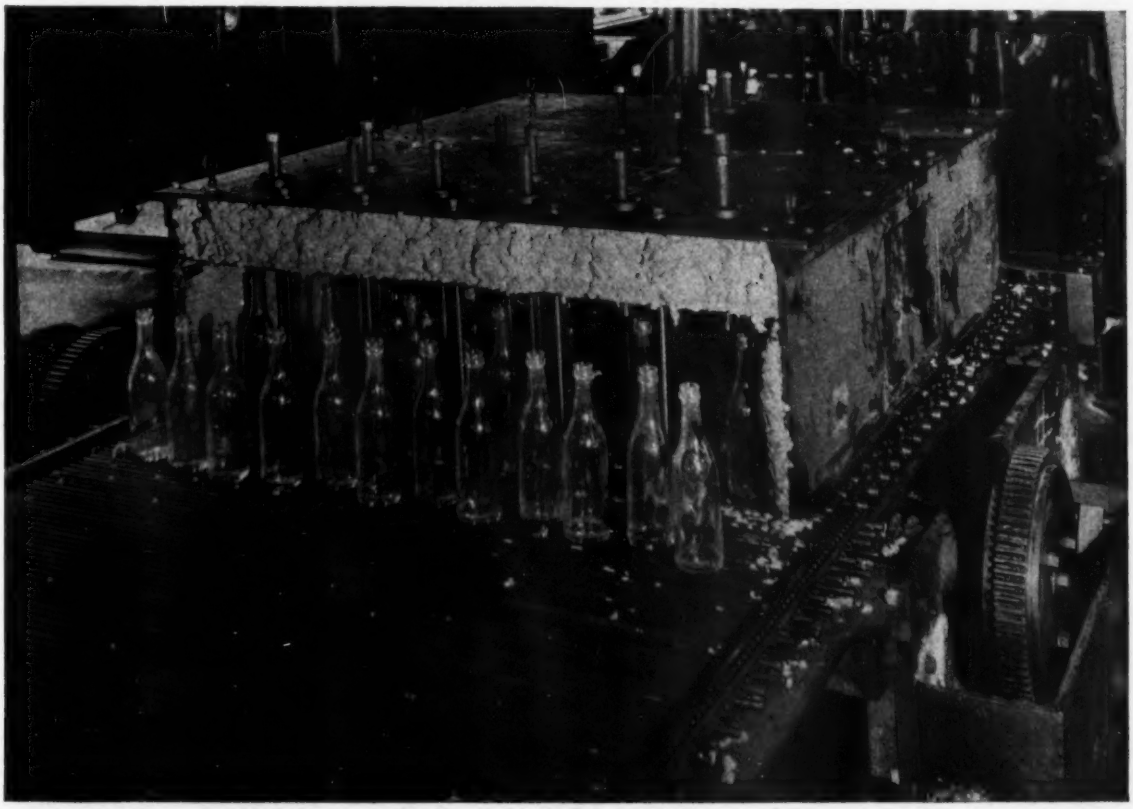

FIG. 3. TOP AND SIDES OF SOAKING CHAMBER TEMPORARILY REMOVED, EXPOSING ROW OF BOTTLES FORMED AS RESULT OF THE SEEMINGLY COMPLICATED BUT, IN REALTY, SIMPLE MOTIONS BACK AND FORTH OF THE 15 USHERS COMPRISING THE COMPLETE STACKER SYTEM.

In Fig. 1, the machine take-out is seen transferring a bottle from the mold to the top of the pneumatic elevator, which, as mentioned, raises it the moment it is released, to the level of the revolving roller conveyor. The wipe-off automatically slides the article on to the conveyor which carries it through the opening, just big enough to admit the ware, in the front wall. The closed front protects the ware from cold drafts, and delivers it in proper condition for annealing to the automatic stacker just inside the entrance. By means of these devices, each of the bottles consumes exactly the same amount

of time as all the others and gets the same degree of exposure in making the trip, which is conducive, of course, to uniformity of annealing.

The bottle enters cooled sufficiently to keep its shape but containing enough heat, if conserved, to anneal itself perfectly, commercially speaking, while passing through the soaking and annealing chambers, and no addition of heat is needed. Theoretically, each bottle in its passage goes in regular sequence through the same phases of heat-treatment in the same elapsed time as any other bottle, and, judging from the actual results obtained at the Peerless Glass plant, 97-98 per cent of the shear-cut that comes through is perfectly annealed.

Fig. 2, shows the front wall of the lehr removed to enable the photographer to make a picture of the bottles rolling in automatically on the roller conveyer to the stacker or distributor. When the bottle touches the first usher of the several comprising the distributor, it gives the finger at the bottom of the supporting usher rod a gentle push and is itself gently guided to the right or left side, as required, coincidently moving forward on the conveyor towards its place in one of the rows beyond the usher. Meantime the usher is left in position to pass the next bottle to the opposite side. A little further on the bottle meets others ushers each of which forms two new rows, and so on, until, in these particular machines, there are twelve rows of bottles going through at one time. This is illustrated in Fig. 3, where the top and sides of the body of the chamber have been temporarily removed to obtain a good view at the rear of the stacker and show how it assembles the ware into rows. Either straight or staggered rows may be used.

Experiments are under way to control the stacker by means of timers on the upper outside ends of the usher arms which support the ushers from the roof of the chambers, so that when it is desired to have several bottles follow the same straight line instead of being turned aside alternately, it will be possible to pass two or three consecutive ones to the same row.

On the floor under the distributor section (Fig. 1) the driving unit for the rollers, including motor and speed reducing mechanism, is placed. On each side of the lehr, half of the rollers are equipped at their ends with small sprocket wheels and sprocket chains (not shown in the photographs) which keep the rods in continuous uniform, slow revolution.

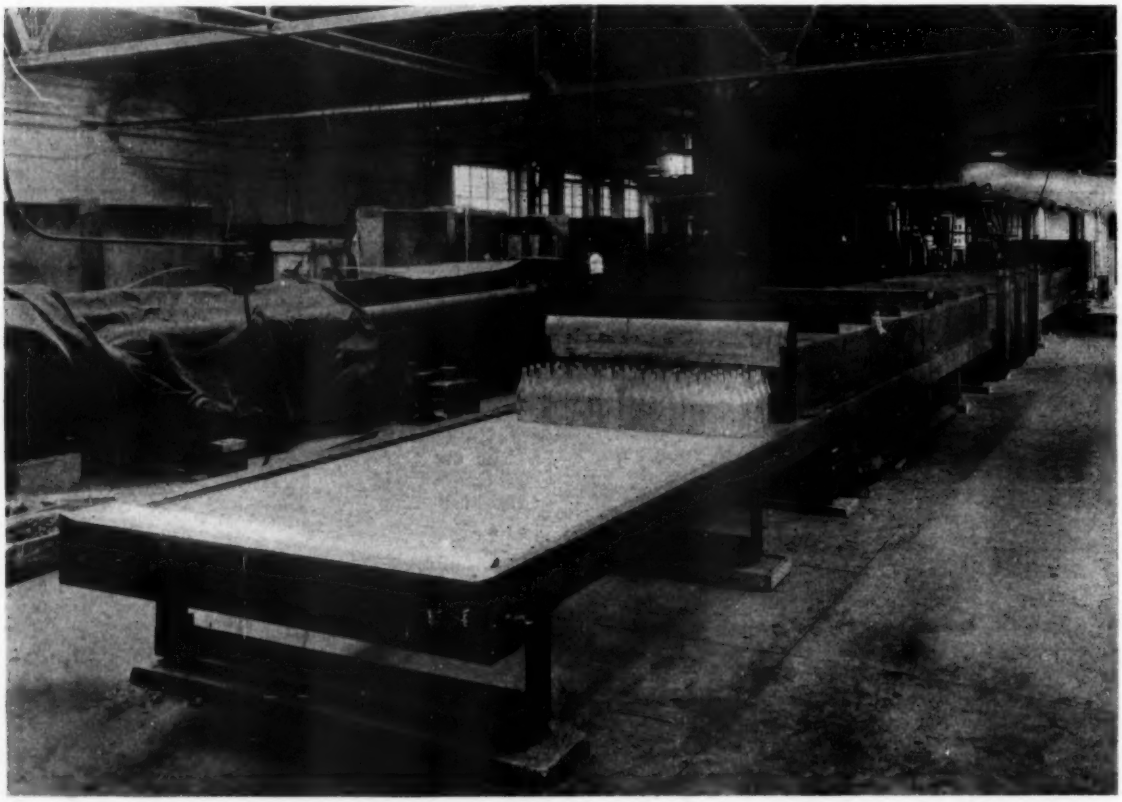

FIG. 4. OUTLET END OF LEHR. ON THE LEFT, THE EARLIEST COMMERCIAL INSTALLATION OF THIS TYPE. IN LEFT BACKGROUND, CRATED MATERIAL FOR TWO NEW LEHRS, COMPLETED AND PUT INTO OPERATION LAST DECEMBER, SINCE WHEN ALL FOUR LEHRS HAVE BEEN IN STEADY OPERATION.

When the ware emerges from the distributing section it enters the soaking chamber through which it proceeds more slowly to the annealing chamber, the conveyor rods in that section and the remaining part of lehr to the packing end revolving at a slower rate than those in front.

Figs. 2 and 3 show the rock wool insulation of top and sides. Under the conveyor rollers also the bottom of the lehr chamber is amply insulated.

The method of supporting the ends of the conveyor rollers in bearings is illustrated. In lehrs of the width here shown, there are three auxiliary supports spaced equally across the conveyor. At the top of each bearing a hole is drilled over each rod for lubricating purposes. Filled with graphite they take care of the rollers and, it is said, require replenishing only about once a year. This can be done very easily. It is only necessary to lift up the short-length guards (not shown in the photographs) covering the ends of the rods on both outer sides of the machine and place the lubricant in the holes provided for that purpose.

Under severe tests, bottles annealed in this plant have withstood hydraulic pressures on quarts up to 450 pounds and on mineral or soda bottles up to 800 pounds. This indicates both good distribution of glass and good annealing.

No one familiar with glassmaking methods as practiced even a few years ago can view in the Peerless Glass Company plant this latest development of automatic glassmaking machinery for eliminating labor, without fully realizing that marvelous advances in equipment and methods have been made within a very short period.

The H. L. Dixon Company has been working on several initial heat lehr ideas, at the same time watching developments at Long Island City, and, finally deciding there was nothing left to work on, the Dixon organization has completed arrangements whereby they have obtained from the Thermal Engineering Corporation exclusive license to market this equipment throughout the entire world.

## Reactions in the Solid Mixture

By Dr. E. Kordes[1]

Up to a comparatively short time ago, there was a general opinion that two substances could only react with each other when in the liquid or gaseous phases. Investigations by different scientists during the last decade, among whom G. Tammann must be mentioned, led more and more to the conviction that the crystallized condition of matter was in no way as slow to react as had previously been assumed. This probably was recognized first in metallography, as the metals belong to those substances that, on the basis of their relatively simple crystal structure, are most quickly in a position to take part in different kinds of chemical reactions in the solid condition. But also in the chemistry of the silicates, there is an entire series of important phenomena that were never understood completely without the consideration of changes in the solid condition, the possibility of reactions between crystals.

Among the reactions in the solid condition there are a number of phenomena that fundamentally can be considered from the same viewpoint. These are: "recrystallization," mixed crystal formation, and finally, the formation of new chemical combinations in the solid state. We shall consider here primarily the type of reaction last-mentioned; however, as the two other phenomena are closely related to the third and play an especially important part in practice, they will also be taken up here.

All reactions in the solid state have a fundamental hypothesis for their being: the atoms or molecules in the crystal lattice of the individual components in the reaction must have a minimum degree of mobility, so that they can undergo a change of location in the solid state. Every substance has a temperature range typical for it, above which the reactions may take place in the solid state. It has been shown that this "critical" temperature, referred to the melting point of the substance in question, is lowest with the metallic elements, somewhat higher with the electrolytes, and highest with the molecular compounds. As a large part of the silicates with relatively complex structure approximate the typical molecular compounds, in general with them we can expect reactions in the solid state only at relatively high temperatures. At temperatures that are still far below the melting point, the silicates must be very slow to react, as has been known in technology for a long time.

If one heats a powder of a pure substance, it will begin to cake together on exceeding a temperature that is typical for the substance in question. In this same temperature region one can observe the formation of new grain boundaries in a pill pressed out of this substance. Simultaneously with this "recrystallization," as it is called, there generally takes place a consolidation of the pressed pill. "Recrystallization" therefore is of extraordinarily great importance for all consolidation phenomena as long as chemical influences or partial fusion do not come in.

The phenomenon of "recrystallization" is a reaction in the solid state that takes place between two chemically similar crystal grains. On the other hand, if one heats a mixture of two different substances, if we disregard the reduction in the melting point, they either will not influence each other at all until the fusion of the mixture starts, or, if they have approximately concordant crystal lattices, they give mixed crystals, or finally, a chemical reaction takes place between the two substances. The reactions between chemically different crystal grains of a mixture generally start only above the recrystallization temperature of the pure components. Only when the mobility of the atoms or molecules of the substances taking part in the reaction has become so great that they can diffuse into the other components, can the reaction take place with a velocity noticeable from the exterior.

A great part of the processes resulting in the burning of ceramic products unquestionably has a connection with the reactivity of the substances in the solid condition. Even on heating the mixture determined for the production of glass, some chemical reactions take place before the first fusion starts.

The reactions in which glasses take part are not truly included in this consideration, as the glasses must be regarded as undercooled liquids. What has been stated above holds for their reactivity with other crystalline substances; however, here, the temperature must be so high that there is a sufficiently great mobility of the atoms and molecules, of the participating substances, that take part in the reaction.

[1] Abstract of a paper read at a meeting of the German Society of Glass Technology.

### World Congress on Illumination

An International Illuminating Congress, attended by the foremost lighting engineers of the world, will be held at Saranac Inn, N. Y., next September. The Illuminating Engineering Society is in charge.

# Twenty Years of Safety Work by One Company

## The Result—368,000 Fewer Accidents—$1,000,000 a Year Saved

### Industrial Accidents Can Be Prevented—Some Records and Proof

By C. W. Price[1]

**This article, the first in a series of ten, will tell our readers how to organize and carry on safety work in their plants along the lines that have enabled other firms—large and small—to reduce accidents 50 to 75 per cent.—EDITOR.**

In the 20 years' history of accident prevention in the United States three facts stand out:

1. The experience of hundreds of industrial plants has demonstrated absolutely that 75 per cent of all disabling accidents can be eliminated in any industrial plant.
2. In any company in which efficient safety work has been done it has paid, not only ordinary dividends, but extraordinary dividends; it has, therefore, been permanently incorporated as a necessary part of plant efficiency in thousands of companies.
3. Not more than 15 per cent of the disabling accidents in the average factory can now be eliminated by mechanical guards or safety equipment. Eighty-five per cent of the preventable accidents must be prevented through organized educational effort that gets the men sincerely interested in protecting themselves and their fellow workers and keeps them interested.

Methods of accident prevention have become standardized and they may be applied, with differences only in detail, to the solution of the accident problem of nearly all industrial organizations. Some hazards are peculiar to certain industries, but most serious hazards, such as material handling, obstructions which may cause falls, unguarded moving parts, and flying particles which may injure the eyes, are common to all. The methods of accident prevention outlined in these articles have been applied successfully to plants in every industry where there is an accident problem. Their effectiveness may be judged from a brief summary of results in a few cases.

The first organized effort for the prevention of accidents in industry was made in the plants of the United States Steel Corporation in 1907. This Company affords an excellent example of what can be accomplished through safety work since it includes in its numerous branches nearly every type of hazard to be found in industry. Despite the size of the Steel Corporation, the results of its safety work are representative of the accomplishments of all types of industrial concerns, small and large.

Twenty years of safety work by this corporation has saved 368,000 men from accident. If a campaign of accident prevention had not been undertaken, and accidents had continued at the same rate as in 1906, 46,000 of these men would have been killed or seriously injured, and the rest injured sufficiently to cause considerable loss of time from work. Comparison of the figures of 1925 with those of 1906 shows that the United States Steel Corporation has reduced disabling accidents 84 per cent, and the corporation has made a net saving of $1,000,000 a year through its safety work.

The Steel Corporation did one thing with excellent results which might be adopted to advantage by any organization. This was the inauguration by the late Judge Gary, several years ago, of the Gold Star Honor Roll Contest. The rules of the contest provided that if, during thirty days, no man of a plant was sufficiently injured to cause him to lose time after the day of injury, that plant was placed on the Gold Star Honor Roll, which was to be printed and posted in every plant. A spirited competition among the managers ensued.

In 1926 the corporation had 306 plants, with 250,000 workmen employed in what was originally one of the most hazardous of industries. In each month of that year, in an average of 175 plants, there were no accidents resulting in loss of time. The 2,800 employees of the Joliet plant of the Illinois Steel Company recently established a record by operating for four months without one accident causing the loss of time of a single workman.

Despite the excellent records being made in the reduction of industrial accidents, there is still a vast amount of safety work to be done, especially in the smaller plants. Industrial accidents in the United States are increasing every year. Between 1919 and 1923, the number of accidents causing loss of time increased 27 per cent. The rate of increase from 1923 to the present time is in many states even greater.

### Only One-Fourth of Actual Cost Insurable

The chief engineer of one of the large insurance companies has estimated that only one-fourth of the actual cost of an accident can be insured. Insurance covers only the liability of the employer for compensation to the injured employe or to his family, while the total cost, he believes, is four times as great. A typical case in which the compensation cost was only a small percentage of the total cost occurred recently. A man was killed, and everyone stopped work to see what had happened. So great was the demoralization that for two days following, only a few men were able to keep up with their regular schedule, and not until a week after the accident was operation back to normal. This example is not extreme; even in a well organized machine shop, everyone stops work when a bad accident occurs, and there is an additional loss when a new man, unfamiliar with a machine, cannot make it produce as much as the man who was injured.

The experience of hundreds of plants has demonstrated that 75 per cent of all accidents in industry can be prevented. This would mean the saving each year of 17,000 lives, the prevention of serious injury to 430,000, and the saving of three quarters of a billion dollars by employers—certainly a goal worth striving for.

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[1] Director, Training Course for Safety Engineers, New York University.

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# Some Recent Improvements in the Manufacture of Flat Glass

By H. K. Hitchcock[1]

**The object of the present paper is to touch on the early methods of making sheet glass; point out the generally accepted methods used; and briefly outline the most recent developments in the industry, giving references to the literature on the subject, so that those interested in it may be able to get in touch with the general line of this development without exhaustive search.**

**The paper deals first with the primitive, hand-operated ways of producing flat glass by spinning, blowing, and casting; the development of the use of power-driven machinery in casting, blowing, and drawing; and finally with the development of the continuous method of casting from tanks and grinding and polishing, with a brief description of an improved method of casting from pots.**

PRACTICALLY up to the beginning of the present century all flat glass used for glazing purposes came under one of the three following categories:

*Crown glass,* which was made by rapidly whirling a hollow sphere of glass on the end of a "punty" or specially shaped iron rod until it was spun into a disk, from which the sheets were cut.[2]

*Window glass,* which was made by gathering a ball of glass on the end of a blowpipe, blowing it into a cylinder, and afterward flattening it into sheet form.[3]

*Plate glass,* in which the glass was rolled out on a metal table, annealed, and afterward ground and polished.

The first of these processes has practically disappeared. In the second one the size and thickness of the glass were limited by the ability of the man to handle the weight of glass involved which resulted in this being a laborious and expensive means of producing a sheet of glass. This process has been almost entirely supplanted by the introduction of machinery in which the glass is drawn either in flat or cylindrical form.

### Mechanically Drawn Cylinders

In the drawing of cylinders, a bait made of cast iron like the mold for the top of a bottle, with a blowpipe attached to it, is lowered into a mass of molten glass; the bait being then raised, a neck similar to the neck of a bottle is first formed. The bait slowly begins to rise and the glass attached thereto is expanded to the size of the desired cylinder by means of the introduction of air to the interior through the blowpipe. The bait then continues to rise at a uniform velocity while sufficient air is introduced into the interior of the cylinder to maintain its dimensions. After it has risen to the height necessary to produce a cylinder of the desired length, the bait then rises very rapidly and air is introduced so as to blow off the end of the cylinder, leaving it suspended from the bait with the lower end open. The cylinder is then taken down by special devices, cut into sections of the desired length, and split and flattened in the flattening oven the same as the old hand-blown cylinder.[4]

### Drawing Sheet Glass Direct from the Molten Bath

While the drawing of cylinders was a very great advance over the hand method, every one recognized that if it were possible to draw glass in sheet form directly from the molten bath, it would eliminate the troubles involved in the flattening operation and should produce a better article at a lower cost. There are several devices for the drawing of sheet glass direct from the bath that are in use today, the three principal ones being the Fourcault process, the Libbey-Owens process, and the Pittsburgh Plate Glass process.

THE FOURCAULT PROCESS. In the Fourcault process the glass is continuously forced up through a slot in a refractory body and the blank so formed is continuously stretched to its desired dimensions in a heated vertical chamber as fast as formed, the tension being applied to the glass sheet by means of rolls which bear on either side of the sheet and elevate it through the "lehr," which consist of a series of vertical chambers having progressively lower temperatures, superimposed one above the other. The glass emerges above the top of this series of chambers annealed, and cooled enough to be cut into sheets of standard sizes.[5]

THE LIBBEY-OWENS PROCESS. In the Libbey-Owens process the sheet is drawn directly from an open bath of molten glass, reheated, and bent over a roller which changes its direction of movement from a vertical to a horizontal plane; it then passes over a continuously moving flattening table and through a lehr in which it is supported on a series of rollers and in which it is annealed and allowed to cool down to the proper temperature for handling. The width of the sheet in the Libbey-Owens process is maintained by means of two pairs of knurled rollers, one on each edge of the sheet, which grip the sheet, roll down the edge, and maintain its width and flatness.[6]

THE PITTSBURGH PLATE GLASS PROCESS. In the Pittsburgh Plate Glass Company's system of manufacture the sheet is drawn directly from the bath of glass, and its position in the bath is determined by means of a submerged bar, which prevents it from wandering back and forth. Its width is maintained by means of a tension in the edge, which is regulated by means of two hemispherical-shaped pieces which partially surround the edges and prevent them from becoming too cold.[7]

The drawn sheet is elevated through a vertical lehr similar to the one used by the Fourcault process, and the glass is

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[1] Consulting Engineer, Pittsburgh Plate Glass Company, Pittsburgh, Pa.
[2] See Rosenhain: "Glass Manufacture" (Van Nostrand, N. Y.), p. 148.
[3] Ibid., p. 159.
[4] This process is fully described and illustrated in a catalog published in 1923 by the Pittsburgh Plate Glass Company, beginning on page 173. This catalog is to be found in most libraries.
[5] See U. S. Patent to Fourcault, No. 901,800.
[6] See U. S. Patent to Colburn, No. 1,248,809.
[7] See U. S. Patents to Slingluff, Nos. 1,559,513, 1,364,875 and 1,544,947, and U. S. Patent to Koupal, No. 1,598,730.

cracked off at the top by heated ribbons which clamp the glass and sever it from the advancing sheet.[8]

In all of these processes the glass to supply the bath from which these sheets are developed is made in a continuous regenerative tank furnace, which is too well known to require description.

However, the requirements as regards quality for the manufacture of glass of this description have led to a very high development in both the efficiency of the tank and the quality of the glass which they produce, and the fact that the glass is entirely handled by machinery has resulted in the production of wider and wider sheets and thicker and thicker glass, so at the present time it is practical to make sheets of almost any desired width and thickness by these drawing methods.

### Former Method of Manufacturing Plate Glass

MELTING. In the manufacture of plate glass, the third of the processes mentioned, instead of the glass being melted in a continuous tank furnace it is usually melted in pots or specially prepared crucibles, which are situated on the hearth of a regenerative furnace of a special type; the sides of this furnace are full of openings, enabling the pots to be easily removed, and the openings are closed by large clay doors called "tuilles."

In these furnaces the batch, which is more carefully selected than for window glass, is charged into the pots through openings in the doors, thoroughly melted and refined at a temperature of approximately 2,600 deg. fahr., after which the furnace and pots are allowed to cool down to a casting temperature of approximately 2,200 deg. fahr. The tuilles are then lifted and the pots removed by huge clamps, which until the beginning of the present century were mounted on wheels and operated manually. The pots being withdrawn, they are thoroughly cleaned, clamped into a pair of teeming tongs, and lifted to a height above the casting table sufficient to enable the glass to be poured on its top in front of a roller.

CASTING. Previous to 1900 this casting table was situated opposite an oven, the hearth of which consisted of bricks loosely laid in sand which had been carefully dressed when cold so as to present a perfectly flat surface to support the glass, the oven having been heated to a temperature at which the glass would still be more or less plastic. This casting apparatus consisted of a cast-iron roller placed on a cast-iron table mounted on wheels on a track, which enabled it to be brought successively in front of one oven after another.

The cast-iron roller on this table was supported upon two metal strips called "trams," equal to the thickness of the glass desired, and spaced apart a distance equal to the width of the desired plate.

The pot, which was supported for lateral movement across the table in a pair of tongs which would permit of the tilting of the pot, was placed adjacent to one end of the roller and tilted to allow the glass to run out on to the table in front of the roller. At the same time the pot was pushed from one end of the roller to the other in such a manner as to spread the glass as evenly as possible on the table in front of the roller. The roller was then caused to pass over the glass so as to roll it out into a sheet in the same manner in which pie crust is rolled. The roller was then removed and the glass shoved into the preheated kiln. These kilns usually would receive three or four plates of glass, the first being shoved to the back of the kiln and the others placed successively in front of it.

ANNEALING. When the kiln was filled with these plates of glass, the opening was closed and as nearly hermetically sealed as could be done, the fires turned off, and the kiln and plates allowed to cool to normal temperature, the process requiring three or four days to accomplish. The glass was then withdrawn, trimmed on its edges, and taken to the rough-glass storage, which was at one end of the casting hall adjacent to the grinding shed. This work all being done manually and the surroundings being very hot, the men worked stripped to the waist, and the red glow from the furnace on their steaming bodies presented one of the most picturesque sights known to any industry.

GRINDING AND POLISHING. This rough glass was then cemented to the tops of rotating tables. Carriages having runners mounted thereon, shod with cast-iron shoes, were then placed over the glass and its surface reduced to a plane by the application of abrasives and water between the top of the glass and the bottom of the cast-iron shoes. The glass was then turned over and ground on the second side, after which it was taken to the polishing shop, cemented to a separate table, and polished by means of the application of rouge to rubbing blocks shod with felt.

### Improved Plate-Glass Casting and Annealing

About the beginning of the present century the first great improvement in the manufacture of plate glass took place in the substitution of huge traveling power-driven cranes for taking the pots from the furnace and pouring them on the table, the introduction of a continuous lehr for annealing the sheets, and the substitution of rotary polishers and transfer tables in the grinding and polishing operation. This process is admirably described and illustrated in the Pittsburgh Plate Glass Company's catalog of 1923, and has continued to be the process by which most of the plate glass has been made up to the present time.

### Changed Demand for Sizes of Plate Glass

Until the advent of the automobile, and especially the closed car, the bulk of the demand for plate glass was for very large sizes such as that used in store fronts, so that all the rough plates of glass were cast in sizes containing 200 sq. ft. or more. After this glass was ground and polished it was carefully inspected and the defects cut out so as to leave the largest plates possible, which left the small glass as a sort of by-product for which the demand was far from equal to the supply; but the coming of the automobile soon changed the character of the sizes in greatest demand, so that it soon became necessary to cut up these large sheets into smaller sheets to supply it. This shift in the market conditions made it possible to start with sheets of much smaller dimensions than before. Consequently new systems of manufacture became possible that would not have been commercially successful in the early days when the demand was almost entirely for large-size sheets.

### Plate Glass from Continuous Tanks

The improvements in the continuous-tank construction and the quality of the glass which it produced had been de-

[8] See U. S. Patent to Slingluff, No. 1,373,533.

veloped to meet the requirements of the various new methods of drawing window glass, so that it was practical to draw glass of sufficient thickness to enable it to be subsequently ground and polished to form plate glass. The trouble, however, with these methods of forming the rough sheet to be subsequently ground and polished was that bubbles or seeds or any defects in the body of the glass in the tanks were drawn out into long lines which magnified the defects in the resulting plates so that only a very limited amount of the melt drawn could be used for plate-glass purposes, the remainder having to be sold as window glass. The various manufacturers therefore began to experiment on rolling processes which might be attached to the tank furnaces, which processes, by eliminating the stretching, would leave the bubbles and other defects more inconspicuous than in the drawing method. The result of this experimentation has been that tank furnaces are beginning to be used to some extent in the manufacture of plate glass.

### Method of Casting Continuously from Tank

One of the most successful of these processes consists in forcing a stream of molten glass through a refractory slot which gives it the preliminary shape, and then immediately before the glass has the time to chill, passing it between a pair of rollers to give it more accurate dimensions, stretching it slightly to make it flat, and then passing it through a continuous lehr wherein it is supported on a series of rollers placed close together so that the resulting sheet is straightened in its path from the hot end to the cold end and annealed and gradually cooled. In this way a continuous ribbon of glass is made that is hundreds of feet in length and up to ten feet in width.[9]

One would suppose it to be a very simple problem to develop a system of manufacture of this kind inasmuch as it seems a direct and simple thing to take the product of the tank, which has reached a high state of development, run it through a pair of rollers (a process which is commonly used in many metallurgical operations), and then anneal it, all of which operations are well known. However, to get a product good enough to be used for polished plate glass is a very difficult operation, indeed, and has required no end of research and experimentation, to say nothing of the expenditure of vast sums of money.

To describe the highly organized mechanism which produces this result would transcend the legitimate limits of a paper of this kind. The author will therefore briefly outline the various steps in the process, referring wherever possible to patents which describe in detail some of the various devices which have been suggested to meet the difficulties involved.

### Batch Handling

The materials for the batch consisting of sand, lime, soda ash, salt cake, arsenic, and charcoal, are all brought in cars to the batch house, where they are dumped, dried, and elevated into large storage bins. From the bottom of these bins the various materials are drawn off in proper proportions, mixed in a rotary mixer which is mounted on a car to enable it to pass in succession under the various bins, and after mixing the batch is deposited in the hopper of an elevator and conveyor system which ultimately deposits it in measured and timed quantities into the end of a large continuous regenerative glass tank.

### Forming the Sheet

There the glass is melted, refined, and discharged through a slot to a pair of water-cooled rollers where it is given accurate dimensions, and from which it passes into a continuous roller lehr, the peripheral speed of the rollers of which is slightly greater than that of the rollers which define the sheet. This difference in speed is controlled so that the operator can take the glass away from the defining rollers at a speed just sufficiently greater than the speed at which it is formed so as to straighten out any wrinkles which may result in the forming operation. Rollers for defining this sheet have to be approximately of a uniform temperature from end to end in order to give the best results. To accomplish this has required no end of experiment.[9] The most satisfactory rollers for this purpose are described in a U. S. patent issued to Hitchcock (No. 1,657,212).

The problem of expansion in a lehr long enough to handle the output of large tank furnaces constitutes a serious problem and has been met by cutting the lehr up into a series of sections with elastic connections between them, and driving them by means of a long shaft running from end to end of the lehr, each element in the lehr having a separate driving mechanism taking off from the shaft.

The controlling of the temperature, and the elimination of the strain in the glass in a long ribbon of this kind are also serious problems and require very accurate temperature control. This is accomplished by means of a series of thermocouples placed in the various sections of the lehrs which accurately record the temperature at a central point, and having a sufficient number of independent heating units to correct the temperature wherever necessary.

### Testing for Annealing

At the one end of the lehr where the sheet emerges from the tunnel, is placed a large polarizer which produces a sheet of polarized light through the glass as it travels along. On one side on a swinging arm is a Nicol prism, which enables the operators to study carefully the strain in the glass by analyzing the polarized light passing through it.

### Inspecting the Sheet

The sheet then passes into a dark room which is provided with a unique system of lighting, the light all being projected through the edge of the sheet on either side. This light impinges on all the defects in the glass and magnifies them so they are easily seen by a person walking on the glass. In this dark room an operator marks the defects that need to be cut out and also indicates the points at which the sheet should be cut in order to eliminate them.

### Cutting Out Defects

After the glass passes out of this dark room it comes on to a cutting table where it is cut to the desired length and then transferred to an elevated platform which is adjacent to the end of the train of tables which carry the glass through the subsequent grinding and polishing operation.

[9] See U. S. Patent to Hitchcock No. 1,538,327, and U. S. Patents to Gelstharp, Nos. 1,532,134, 1,560,077, 1,590,820, 1,560,078, 1,560,079, and 1,615,834.

In a continuous system of casting it is imperative that there shall be no interruption in the movement of the glass once it is started, so there are provided two motors to drive the casting rolls and the lehr mechanism, either one of which will be able to do the work should anything happen to the other, and an ample storage battery automatically cuts in should the power go off.

### Continuous Grinding and Polishing

Starting with a ribbon of glass which has given dimensions, it is a simple matter to cut it into standard lengths so that instead of having a big variety of sizes which it is necessary to grind and polish, practically all of the glass which goes into the grinding and polishing departments is of a standard size. It is possible to lay a product of this kind on a continuous grinding table and pass it successively under a series of motor-driven grinders, where the glass is first ground plane and given a fine smooth, and then polished. The grinding and polishing departments are situated in a long building located between two continuous casting units so that the glass can be taken directly from the ends of the lehrs and delivered to the grinding tables. This grinding and polishing apparatus consists of four parallel tracks running from one end of the building to the other, two being used to support the tables during the grinding and polishing operation, and the other two for the return of the tables from the polishing end to the grinders[10]

### Laying the Rough Glass

The rough glass being delivered at a central place, which is at one side of the place where it is laid at the beginning of the grinding, a simple mechanical device takes the glass directly from the end of the lehr and deposits it on to the tables on which it is to be ground.

### The Grinder Tables

These are cast-iron tables mounted on wheels provided with Timken roller bearings. The bearings are placed in thimbles which are eccentric to the holes in the frame of the tables, so that by rotating them it is possible to adjust the tables accurately for height.[11] These tables are provided on each end with flat dowels so placed that when two tables are shoved together, their top surfaces register perfectly, and by the adjustment in the wheels it is possible to make the cars both bear equally upon the track upon which the tables are mounted. The track is laid perfectly level and secured to steel framework, so that as the tables start from one end of the grinding shop to the other end of the polishing shed they move in a straight line with their tops always in the same plane. They are driven by a large spur gear which meshes into a rack secured to each table, so that they are pushed from the laying yard to the stripping yard at the other end of the polishing shop.

The tables are also held together by means of special couplings consisting of latches which are easily brought in contact, and then they are clamped together by the movement of a lever which is eccentrically mounted in the eye of the latch, so that when the lever is pulled it clamps the tables securely together.[12]

### The Grinder Runners

Spaced apart over the tops of the tables which carry the glass as it passes through these processes are a series of resiliently supported and detachably mounted grinder units driven by motors, each grinder runner being mounted to permit a limited universal movement,[13] and fed with sand or other abrasive, each successive runner receiving a grade of abrasive finer than the one preceding. This sand is fe through the center of the runner and is distributed by means of cast-iron blocks attached to the runner bottom. It is necessary that the runner iron should be so distributed on the bottom of this runner as to equally distribute the sand over the glass and at the same time present to each square inch of the glass the same amount of grinding effect in order that the resulting surface of the glass shall be perfectly plane.

The successful handling of the abrasive for this operation requires a complicated apparatus which will be dealt with later.

### The Polisher Runners

After the glass has been thoroughly jointed and the plaster given time enough to harden, the train of tables passes under a series of polishers which are substantially the same as the grinders except that the runners which apply the rouge to the glass consist of a series of spiders carrying loosely mounted pins which are free to move up and down. On the bottom of these pins are a series of cast-iron blocks with felt attached to their lower faces.

Rouge in various qualities is fed to the felted runners in quantities suitable to the work required of it. It is quite imperative that the amount of rouge fed to the runner should not be sufficient to burn the glass before it has been thoroughly polished, and also quite necessary that the block should be kept soft at all times to prevent sleeking the glass, which will occur if the proper composition of rouge is not fed to the blocks.

### Transferring of Tables

After the glass has passed under a series of these runners it becomes polished and passes out into the stripping yard where the tables are disconnected from the train by a small electric locomotive, drawn on to the transfer table,[14] and transferred to another track on which they are shoved and where an endless chain picks them up and returns them to the laying yard at the other end of the grinding and polishing shop.

### The Turnover Yard

The glass is here turned over by a machine identical with the one which originally laid the glass on the first side. This machine consists of a traveling crane on which is a vacuum-cup frame mounted on a trolley and provided with a hoist. On the lower side of this frame are a series of vacuum cups which, when allowed to come down in contact

[10] This general scheme is described in U. S. Patents to Fox, Nos. 1,492,974 and 1,554,804, U. S. Patent to Fox et al., No. 1,610,366, and U. S. Patent to Evans, No. 1,657,206.

[11] See U. S. Patent to Evans, No. 1,583,785.

[13] See U. S. Patent to Fox, et al., No. 1,610,366.

[12] See U. S. Patent to Soderberg, No. 1,580,175.

[14] See U. S. Patents to Evans, Nos. 1,577,457, 1,596,604, and 1,598,763.

with the upper surface of the glass and the air is exhausted, fasten themselves to the sheet securely. The frame is then lifted to remove it from the tables, and the sheet of glass is transferred into a U-shaped frame while it lies in a horizontal direction. The vacuum cups are then released and the U-frame rotated through an angle of 180 deg., and the vacuum frame is again dropped on to the top side of the glass which was originally the bottom. It is then taken out of the U-frame and carried over to the waiting tables, to which it is cemented as was done in the first place.[15]

### Stripping, Dipping, and Cleaning

After the glass has been laid on the second side and the plaster allowed to set, it is run through a second series of grinders and polishers and comes out at the further end of the second group of polishing machines a finished product. Here the glass is lifted from the table by means of a vacuum frame and piled on racks, which when full are picked up by cranes and lowered to the floor below and placed in a tank of weak muriatic acid and left there long enough to change the sulphate of lime to muriate of lime, which latter is soluble in water and enables the glass to be more easily washed and cleaned.

The glass having been taken out of the acid tanks, it is rinsed in clean water and then transferred to other cars which carry it to the cutting room where it is inspected, sorted, and cut to size.

This process goes on continuously for twenty-four hours, except that the warehouse where the glass is inspected and cut is run on an eight-hour basis, the glass accumulating during the night being stored on cars.

### Grading and Handling the Abrasives

Returning to the grinding and smoothing operation—which is the prime essential to the success of the whole process—it is necessary in a plant of this kind to feed to the various grinders large quantities of abrasive per minute in various sizes. In order to accomplish this a device has been perfected which takes the rough sand, pumps it into a large inverted cone where it is separated into grades, and these grades are automatically fed from the cone to the grinders, each grade being taken from a different position in the cone. The sand which feeds the first grinders being the coarsest, is taken from the inverted cone at its apex; the subsequent grinders are fed with grades of sand taken from positions higher up in the cone, that is, further away from the apex, each grade of sand being finer than the one preceding due to the fact that the upward velocity in the cone decreases as the area increases and the various volumes of sand and water are removed and fed to the grinders.[16]

The flow of coarse sand to the system is regulated by automatic means of measuring the density of the grinding sand in the apex of the cone. Also automatic means are provided for regulating the velocity of the pumps to insure a constant overflow from the top of the cone. A description of this device would require more space than could be devoted to it in a paper of this kind.

The mechanism which drives the train of grinding tables is also provided with two motors connected through ratchets, so that should anything happen to one of the motors the other will continue to drive the system; these motors are so connected through relays that if the power goes off which supplies them, all of the grinding and polishing elements are automatically raised up out of contact with the glass.

Relays placed in the power circuits of each of the grinders and polishers automatically raise their respective runners whenever their motors cease to function from any cause whatsoever.

### Casting Pots Between Rolls

The use of a tank furnace for the making of glass of the very highest grade presents certain difficulties. When the tank is new and the blocks of which it is built are in perfect condition, the quality of all of the glass produced in it is apt to be satisfactory if other conditions are what they should be; but the amount of glass of satisfactory quality becomes less and less as the blocks wear away, entailing a very large shrinkage and resulting in higher and higher cost, until it becomes necessary to put out the tank and rebuild it.

The making of glass in pots is not open to this objection, but in casting it on a table as was done in the old process the mechanical qualities of the sheet are not nearly as good as where the glass is rolled between two rollers. A device for rolling flat glass in very long sheets has therefore been developed which combines the advantages of a pot furnace for making glass of high quality with the advantages of the continuous rolling process in producing a sheet of uniform thickness.

It will be readily understood that if the glass is cast absolutely uniform in thickness it can be cast much thinner than where the thickness varies considerably, so that not only is the cost of the additional metal which goes into the thicker sheet saved, but also the cost of grinding away the superfluous glass.

In order to accomplish this result one of the most successful systems consists of a large hollow roller which is continuously rolling on a pair of shafts which support it from the inside. Above this roller is another roller which is continuously turning and which is spaced a distance from the big roller necessary to get the thickness of glass required.

The glass is melted in pots exactly the same as if to be cast on a table, but is teemed between the large and small roller and rolled at a high velocity, producing a sheet 60 or 70 ft. in length and of the required width and thickness. This sheet is fed into the hot end of a lehr on a series of rollers which have a peripheral speed equal to that of the big roller on which this glass is dumped, but as soon as the sheet is perfectly formed, these rollers, by means of automatic devices, are slowed down to the speed of the roller lehr through which the glass is fed, annealed, and cooled, as in the continuous process.[17] By this method sheets of very accurate dimensions are made, and this has contributed largely to the improvement on the old method. The glass cast in this manner can be ground either on the old rotary grinders and polishers, or it can be ground and polished in a continuous machine like that described in the tank process.

[15] See U. S. Patent to Heichert, No. 1,519,256.

[16] See U. S. Patents to Hitchcock, Nos. 1,596,658, and 1,629,502, and to Soderberg, No. 1,556,730.

[17] See Reissue of U. S. Patent to Showers, No. 16,755, Showers Patent No. 1,579,666, and U. S. Patent to Hitchcock, No. 1,638,769.

# The Glass Industry

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## CONTENTS


| | Page |
|---|---|
| The Use of Barite in Soda Lime Flint Glasses | 97 |
| Society of Glass Technology | 98 |
| A Unique Lehr | 99 |
| Reactions in the Solid Mixture | 103 |
| Twenty Years of Safety Work by One Company | 104 |
| Some Recent Improvements in the Manufacture of Flat Glass | 105 |
| Editorial: | |
| Suppliers of Raw Materials Welcome Control | 110 |
| Technical Consultation Service: | |
| Glass Wool as Heat Insulating Material | 111 |
| Glass for Electric Insulators | 111 |
| Modern Glasshouse Refractories | 111 |
| Recent Patents | 112 |
| New Patents on Use of Barium Sulphate and Sulphite in Glass | 113 |
| Glass Factory Equipment and Supplies: | |
| Wellman Mechanical Double-Bell Fuel Feed | 115 |
| Cleaning Lenses | 115 |
| Tractors Prove Useful in Glass Plant | 115 |
| New and Handy Flexible Bolt | 115 |
| The Glass World and What It Is Doing: | |
| The Glass Blowers Appeal to President Coolidge | 116 |
| German and English Technologists to Meet Jointly at Aachen | 116 |
| Proposes Contest in Design by Glass and Ceramic Artists | 117 |
| Polished Plate Glass Production for First Quarter | 117 |
| X-Rays in Ceramics | 117 |
| Trade Activities | 118 |
| Industrial Publications | 118 |
| Recent Deaths | 119 |
| Coming Meetings | 119 |
| Inquiries Received | 119 |
| What the World Wants | 119 |
| Glass Stock Quotations | 119 |
| Current Prices of Glass-Making Materials | 120 |
| Monthly Summary of Foreign Commerce in Glass | 120 |

CLASSIFIED BUYERS' GUIDE, PAGE 18
INDEX TO ADVERTISEMENTS, PAGE 20


## Suppliers of Raw Materials Welcome Control

There was a time—and that not very far distant—when the glass manufacturer suffered severe losses from time to time, due to imperfection of raw materials, sold to him by unscrupulous manufacturers or dealers. But this condition is a thing of the past. Improved methods of production, of mining, refining and purification, careful supervision of every step in the manufacture of raw materials, or in their production from mines and quarries have made imperfections in them a rare occurrence. Today the purity and constancy of the raw materials leaves little to be desired.

The explanation of this fortunate state of affairs is obvious. There is too much competition, there is too much striving for business, even for small orders that cannot possibly be a source of profits, to offer anything but materials of the highest grade of purity. If material is found to be other than represented, there are competing firms, ready to supply the demand, and willing to guarantee purity and chemical composition of the materials offered for sale.

It is the man who supplies the chemicals to the glass industry, who is doing the worrying today. Every time a pot of glass is faulty, which may be due to a number of causes, the source of the trouble is sought where it is most unlikely to be: in the materials used. It does not occur to the glass maker that mistakes in weighing the materials, poor mixing, faulty batch proportions, lack of temperature control, bad annealing, etc., may be the reason of his failure to obtain the best results.

This is quite understandable. It is human nature to look for the causes of failure outside of one's self. The glass is of poor quality, therefore it must be the soda ash, the sand, the feldspar, that are at fault. The color is poor, therefore the decolorizer must be to blame. The materials are examined in a cursory manner. Slight differences in color, fineness or texture are pointed out, and are made to appear as causes of the difficulty. It helps not to remonstrate that slight differences in the points mentioned may have nothing whatever to do with the chemical composition and purity. Frequently a carload of material is refused on some pretext, found later to have no foundation whatever.

The conscientious manufacturer of raw materials is in this manner subjected to a great deal of unnecessary worry and trouble. Time and again it happens that chemical analysis of materials, said to cause defects in glass, show them to be exactly as represented, and to come up in every detail to the requirements as to composition and purity.

This reduces the already slim margin of profit to the vanishing point, or may turn it into an actual loss. Materials should never be refused for any reason but well substantiated complaints.

It is mainly for this reason that the manufacturer of raw materials for the glass industry welcomes the employment by glass manufacturers of competent chemists. They know full well that they can only gain by careful, accurate supervision of the materials furnished. The majority of them know that their materials can stand the most rigid tests as to composition and purity. They realize that scientific control will prevent many an unfounded and unjust complaint, that is now cutting heavily into their profits.

# Technical Consultation Service

## Glass Wool As Heat Insulating Material

QUESTION 114.—How is glass wool made and how is it applied to steam pipes?

ANSWER.—Glass wool is being used for heat insulation to some extent. Its properties are such as to make it highly desirable. It will stand high temperatures, is proof against fire and moisture

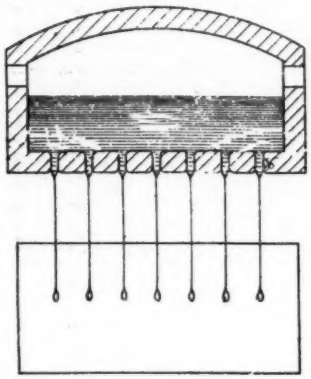


FIG. 1

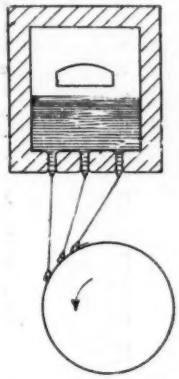


FIG. 2

and has a low specific heat. Glass wool is not subject to decay and rodents will not attack it.

The material compares favorably with powdered cork, Sil-O-Cel powder, slag wool, magnesia and asbestos.

Glass wool is made by melting cullet (broken glass) in a tank (Fig. 1), having openings in its bottom. A revoluble cylinder is located below the tank. The glass drops, flowing out of the openings, draw glass threads which are wound up around the cylinder (Fig. 2) when the drops are in contact with the surface of the cylinder.

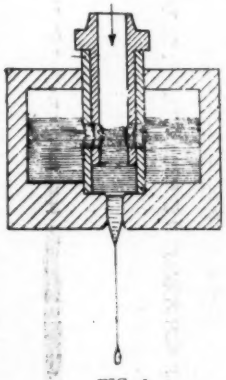


FIG. 3

The molten glass flows out through the openings either by its own weight or with the aid of pressure. A form of construction of an apparatus in which pressure is exerted upon the glass mass is shown in Fig. 3.

The method of covering a steam pipe is shown in Fig. 4. (A) is the glass wool, which is applied to the steam pipe (S) in the form of long threads. To keep the layer of glass wool in place, it is first tied with pieces of string, and subsequently a layer of metal gauze (B) is wound around the glass wool. The whole is then covered by a layer of plaster of Paris (C), which is first mixed with water containing a certain amount of glue. After the plaster has hardened, it is surrounded by a layer of cotton fabric (D). The latter can be painted in any color desired to distinguished it from other pipes.

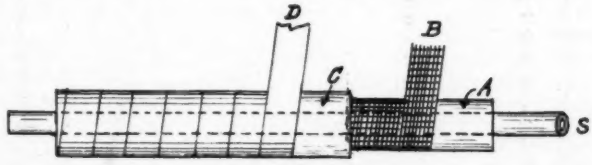



FIG. 4

Heat insulation thus made will not easily break, it can be hammered, without danger of cracking. In this respect it is to be preferred to other insulating materials, which break on slight shocks.

QUESTION 115: Please advise me as to the chemical composition of glass suitable for the manufacture of electric insulators?

ANSWER: A glass which has very high insulating power, low coefficient of expansion and great stability is described by Fred M. Locke, of Victor, New York as having the following composition:

| | |
|---|---|
| Silica ($SiO_2$) | 78.73% |
| Oxides of Iron and Aluminum ($Fe_2O_3 + Al_2O_3$) | 0.86% |
| Lime (CaO) | 1.33% |
| Sodium oxide ($Na_2O$) | 4.24% |
| Potassium oxide ($K_2O$) | 0.62% |
| Boric oxide ($B_2O_3$) | 14.22% |

## Modern Glasshouse Refractories

A paper presented by S. R. Scholes of the Federal Glass Company, Columbus, O., at the February meeting of the Refractories Division of the American Ceramic Society at Atlantic City described improvements made during the last few years in glass plant refractories.

Dr. Scholes classified the refractories used in glass works as including walls for molten glass containers, walls to retain heat or convey flue gases, fuel gases and air for combustion, etc.; brick and tile for heat storage and transfer, in the checkers of regenerators or recuperators.

Because of the great increase in the production of tank glass and the high temperatures at which tanks are now operated much attention has recently been given to the subject of refractories. Considerable research work following the discovery of mullite and its identification as the stable compound in fire clay bodies, has been carried on with satisfactory results. Mullite is now being largely utilized in various types of tank blocks and one concern has successfully developed a process of casting the block from fusion, producing a massive structure of crystalline material in a glassy matrix. Another concern binds mullite crystals with clay. A third uses an organic compound for molding, and depends on the interlacing of the crystals for final structure. Tests have shown these blocks to be of superior quality. Improved methods of mixing raw materials and forming the block and better firing have resulted in adding to the useful life of the refractories.

The point was made by the author that if the various types of newly developed blocks are to give, say twice the service of the blocks formerly used, it is obvious that the other parts of the tank must be made to endure for the same period. Some thought must be given to the question of the durability of silica brick for crowns, jamb-walls, and fire brick for up-takes, checker-chambers and checker brick.

With the long-lived new blocks in use there will be a tendency on the part of the manufacturers to force still greater tonnage through the tanks at higher temperatures and this means that better refractories will be demanded in all parts of the structure. Assuming that furnace repairs will be necessary at much less frequent intervals than formerly, the increased cost of better refractories all through the structure will be more than off-set.

The author discussed the subject of insulation of furnace crowns, jamb-walls, regenerator chambers, etc., and believes that this is a field offering attractive results. The salvaging of a large part of the heat now lost by radiation makes insulation a very economical proposition. A further advantage of insulation is in places where higher temperatures are required or constant temperature desired.

Still another advantage is, that retaining more of the heat in the furnace would have a very beneficial effect on the workmen who would enjoy greater comfort and could accomplish more accurate and speedy results if relieved of the oppressive heat incident to glass working processes, particularly in summer weather.

To accomplish these results a refractory brick would be necessary capable of bearing a load and resisting the fluxing action of batch fumes and dust while sustaining a temperature of 2,700 deg. F. or higher throughout the brick.

## Clinical Thermometers

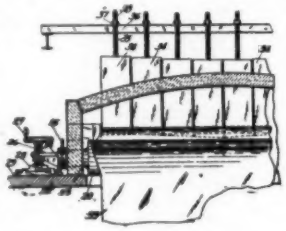
A conference of producers, distributors and users of clinical thermometers approved a standard establishing minimum requirements in quality, effective October 1, 1928. One year will be allowed for clearance of stocks.

# Recent Patents

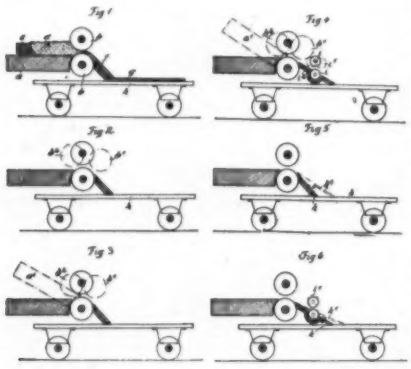
**NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT**

**Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington D. C. Price 10c each**

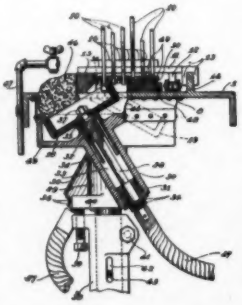
FLOWING AND DRAWING CONTINUOUS SHEET GLASS. U. S. 1,663,628. Mar. 27, 1928. Enoch T. Ferngren, Toledo, O., assignor to Libbey-Owens Sheet Glass Co. Filed 10/20/22. The method of producing sheet glass, which consists in providing a constant flow of molten glass through a containing receptacle, retarding the central portions of the flow to compensate for the retardation caused by the sides of the receptacle, and flowing this uniform stream of glass over and under a detached overflow lip at the end of the receptacle, the glass sheet being drawn from the uniting streams at the lower edge of this lip.



MANUFACTURE OF RAW PLATE GLASS ON MULTIROLLER GLASS-ROLLING MACHINES. U. S. 1,665,427. April 10, 1928. Lambert von Reis, of Herzogenrath, Germany, assignor to Maatschappy Tot Beheer en Exploitatie Van Octrooien, Amsterdam, Netherlands. Filed 11/5/26. A multi-roller glass rolling machine for manufacturing raw plate glass, comprising a tiltable receiver for the molten glass mass to be rolled out, a tiltable rolling mechanism, chutes and guide rollers for guiding the glass plates emerging from the rolling mechanism, and means adapted to be connected with and disconnected from the said chutes for altering the length and accordingly the inclination and height of the chutes.

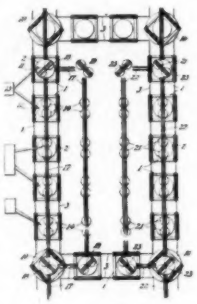


MACHINE FOR ROUNDING THE EDGES OF GLASS SHEETS. U. S. 1,665,040. Apr. 3, 1928. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 4/8/26. A machine for rounding the edges of glass sheets, comprising an abrading wheel provided with a plurality of circumferential grooves, a corresponding plurality of pairs of roughing wheels arranged in series in staggered relation in advance of the grooved wheel, and means for supporting and carrying a plurality of sheets of glass in parallel relation over the roughing wheels and then over the grooved abrading wheel, the members of each pair of roughing wheels having their axes of rotation oppositely inclined obliquely to the plane of the sheets, so that the face of one of each pair of roughing wheels engages one of the corners at the edge of the sheet, and the other wheel of the pair engages the other corner at such edge of the sheet.

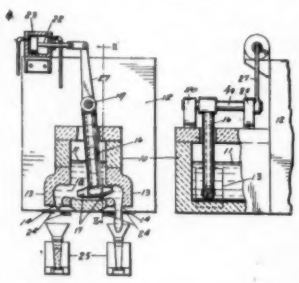


MANUFACTURE OF STRENGTHENED GLASS. U. S. 1,665,413. April 10, 1928. Percy Herbert Head, of Attenborough, England. Filed 4/4/27. Laminated glass, comprising a plurality of sheets of glass having interposed between adjacent sheets a celluloid strengthening sheet, a cementing material for uniting said celluloid sheet to the glass sheets, and a combined solvent and chromatic stabilizing mixture comprising industrial spirit, amyl acetate, and tetrachlorethane in substantially the proportions of 3 parts of industrial spirit, 3 parts of amyl acetate, and 2 parts of tetrachlorethane.

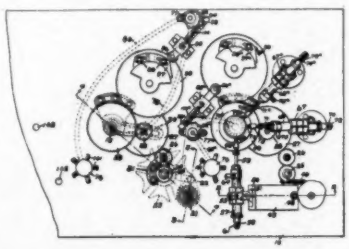
PROCESS AND APPARATUS FOR GRINDING AND POLISHING GLASS. U. S. 1,665,117. Apr. 3, 1928. Frank Edwin Slocombe, of Kirk Sandall, England, assignor to Pilkington Bros., Limited. Filed 11/6/24. Apparatus for grinding and polishing plates of glass, of the type in which the glass is laid on tables which are rotated under grinding and polishing runners to effect the grinding and polishing, comprising a truck carrying each table, means on each truck adapted to rotate the table, rails on which the trucks are adapted to travel, means operative to move the trucks along the rails, a grinding runner frame and a polishing runner frame adapted to travel with each table during the operative course of each runner frame, a runway for the grinding runner frame and a runway for the polishing runner frame, the said runways forming each a closed circuit of which a portion is adapted to support the runner frames while traveling with the tables while the remainder is a return circuit.



GLASS FEEDER. U. S. 1,665,362. April 10, 1928. Victor E. Hofmann and Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 3/27/24. Apparatus for feeding mold charges of molton glass, comprising a container for the glass having a submerged lateral discharge outlet, a spout communicating with said outlet and terminating in a downwardly opening orifice, an impeller disposed in said container, the said impeller having a rounded projection at its lower end adapted to enter the inlet portion of said spout, means for periodically oscillating the impeller toward and from the outlet, and means for severing mold charges from the glass discharged from said spout at each oscillation of the impeller.



DECORATING APPARATUS. U. S. 1,665,321. April 10, 1928. Alvah C. Parker, Toledo, O., assignor to Libbey Glass Manufacturing Co. Filed 3/25/26. In apparatus of the character described, a rotatable vacuum chuck adapted to hold a glass article to be decorated, means for imparting a step by step rotation to said chuck, a bracket having a horizontal slideway therein, a slide in the slideway, said slide being provided with a vertical slideway, a carriage mounted for reciprocation in said vertical slideway, a holder mounted for substantially horizontal reciprocation in said carriage, stylus points on said holder adapted to contact an article on said chuck in one position of said holder, a vertical shaft, a cam on said shaft adapted to reciprocate said slide, a horizontal shaft geared to said vertical shaft, a cam on said



horizontal shaft beneath said carriage and a roller on said carriage in position to rest on the last said cam, said roller being elongated so as to continue to rest on said cam when the slide is reciprocated horizontally.

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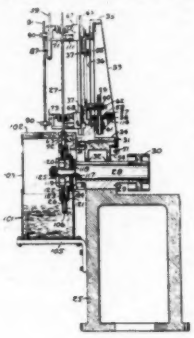
GLASS-GRINDING MACHINE. U. S. 1,663,320. Mar. 20, 1928. Edgar R. Stoddard and Louis C. Zilky, South Bend, Ind., assignors to the Studebaker Corp. Filed 6/11/25.



In a machine for grinding the edges of glass sheets, a stationary base provided with a carriage, a table provided with a groove, a grinding wheel positioned in line with said groove and projecting from beneath said table, means on said carriage for holding a sheet of glass in upright position with the lower edge thereof in said groove and for holding it against relative movement in relation to said carriage, and means for moving said carriage back and forth across said base whereby an edge of the sheet of glass may be moved across said grinding wheel in contact therewith to grind the same.

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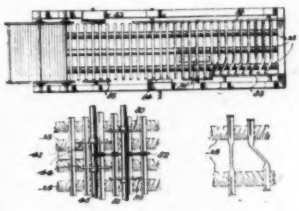
MACHINE FOR FINISHING GLASS TUBES, BARS, VIALS, BOTTLES AND THE LIKE. U. S. 1,664,154. Mar. 27, 1928. Leon Jean Broche, Vineland, N. J., assignor, by mesne assignments, to Kimble Glass Co. Filed 3/23/27. A hopper or container adapted to deliver glass rods, bars or tubes one at a time to paired conveyer screws, each screw having a continuous thread similarly changing in pitch at a point intermediate its ends, one screw of each pair being provided with a right-hand thread and the other with a left-hand thread, and the two screws being arranged to rotate in relatively opposite directions; means for suitably heating said rods, bars or tubes during their lateral advance, effected by the screws; means for applying a longitudinal pulling or compressing force to the bodies so heated, tending to lengthen and reduce, or to compress and expand, the heated and softened portion or portions of said bodies; means for shaping the heated and softened bodies; means for severing the same; and in the case of tubes, means for closing the two open ends formed by severance of a tube, to produce closed bottoms for bottles, vials, and the like. The lower left-hand figure shows a means for longitudinally pulling or pressing a rod or tube and severing the same at a point between its ends.



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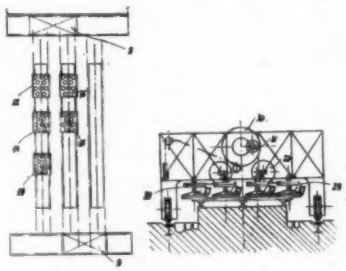
SMOOTHING AND POLISHING GLASS OR THE LIKE. U. S. 1,665,776. April 10, 1928. Paul Joseph Maximilien Escole, Jeumont, France. Filed 3/19/24. Smoothing and polishing apparatus comprising a battery of stationary tables of great length, whereon the material undergoing treatment is adapted to be secured, fixed side by side in spaced, parallel relation; parallel tracks extending along the opposite ends of the tables at right angles to the latter; carriages adapted to travel along said tracks; and abrading devices adapted to travel longitudinally over said tables for polishing the material secured thereon from end to end thereof, and adapted to be moved from the end of one table to that of the next by means of the carriages.



# New Patents on Use of Barium Sulphate and Sulphite in Glass

GLASS AND ITS MANUFACTURE. U. S. Patent 1,665,693. April 10, 1928. Elbert E. Fisher, Toledo, O., assignor of one-half to George W. Batchell, Toledo, O. Filed 4-5-27. An abstract follows:

This invention relates to the use of barium sulphate in the manufacture of glass in such a manner as to serve as a flux and hardener aiding in the melting of the batch used in making the glass, enabling a lower temperature than would otherwise be required to be employed for this purpose and thereby reducing the cost of production of the glass by this fuel saving, as well as by a reduction also in the aggregate cost of the batch ingredients used. The use of barium sulphate, according to this invention, also gives to the glass produced a resistance to changes of a spontaneous character or from external influences so that less solubility or bloom is developed than in various otherwise similar glasses made without the use of barium sulphate. Further, glass produced according to this invention has an improved or greater density and also an improved mechanical strength, elasticity and toughness and a decreased brittleness and lower co-efficient of expansion than glass prepared from an otherwise similar batch without the use of barium sulphate.

The following comparative formulas are given as exemplifying the employment of the invention.

Typical window glass batch formula not embodying the invention, is: Sand, 100 pounds; Soda ash, 28 pounds; Salt cake, 8 pounds; Limestone, 28 pounds; Arsenious oxide, 1 ounce.

Window glass formula embodying this invention, is: Sand, 100 pounds; Soda ash, 26 pounds; Barium sulphate, 4 pounds; Limestone, 28 pounds; Arsenious oxide (with or without) 1 ounce.

Typical batch formula for glass suitable for jars or bottles, not embodying this invention: Sand, 100 pounds; Soda ash, 48 pounds; Limestone, 16 pounds; Feldspar, 2 pounds; Salt cake, 1 pound; Arsenious oxide, 1 ounce.

Typical batch formula for glass suitable for jars or bottles embodying this invention: Sand, 100 pounds; Soda ash, 37 pounds; Limestone, 20 pounds; Barium sulphate, 3 pounds; Arsenious oxide (with or without) 1 ounce.

By way of still further exemplification of the invention, reference is made to another typical batch formula for making glass suitable for the manufacture of bottles and similar articles as heretofore used: Sand, 100 pounds; Soda ash, 38 pounds; Burnt lime, 10 pounds; Selenium, approximately 20 grains; Cobaltic oxide, approximately 4 grains; Arsenious oxide, approximately 1 to 2 ounces.

By applying the principle of this invention to a formula of this character, such formula may be modified by reducing the quantity of soda ash used and by employing limestone instead of burnt lime and employing barium sulphate as an additional batch ingredient, so that instead of the batch formula just referred to the following may, for example, be employed according to my present invention: Sand, 100 pounds; Soda ash, 37 pounds; Limestone, 18 pounds; Barium sulphate, 3 pounds; Selenium, approximately, 20 grains; Cobaltic oxide, approximately 4 grains; Arsenious oxide, approximately 1 to 2 ounces.

Limestone is a less costly ingredient than burnt lime and further an especial economy is secured by the use of barium sulphate according to this invention for the reason that the use of barium sulphate reduces, by as much as from 100 to 200° F., the melting temperature required in the tank in which the glass batch ingredients are melted.

In many formulas wherein it has heretofore been deemed necessary, in producing glass for making bottles and similar ware, to use some form or combination comprising alumina such as feldspar, hydrated alumina, bauxite, clay or lepidolite, it is, when employing barium sulphate, according to this invention, unnecessary to use any form or combination of alumina and thereby is attained a further economy or saving in the heat required for melting the batch, since a considerably higher temperature is required for effecting proper reaction between alumina and silica in a glass batch than is required for reaction between barium sulphate and silica to produce barium silicate.

The barium sulphate used according to this invention may be either a highly purified or manufactured product or it may be in the form of crude barytes which may be directly used as a batch

ingredient in pulverized form. Small quantities (which preferably and usually will not exceed 5 to 7% by weight of the barytes used) of substances, such as oxides of iron, aluminum and silicon, which may be naturally associated with the barium sulphate in native barytes, do not preclude its use according to this present invention.

In forming a "batch" for glass manufacture, according to the present invention and in which barium sulphate is employed, as an essential ingredient, the batch is preferably formed without the use of any carbonaceous or other reducing agents, such as have heretofore in certain instances been used and considered necessary in forming glass batches including barium sulphate for the production of transparent glass. According to this invention, by forming the batch without any reducing agents and by melting it without any reducing agents being present at the time of melting, the special advantage is attained among others that selenium or manganese dioxide may be effectually employed as decolorizing agents in this process which is not the case when barium sulphate and carbon or other reducing material are used together.

It is a characteristic feature of glass manufactured according to this invention that the finished product or glass is clear and transparent and contains a very small quantity or traces of free sulphur which, by appropriate tests and analysis, is clearly identifiable and effective to distinguish glass produced according to the present invention from any of the most nearly similar glasses which have heretofore been produced.

It has been proposed to use barium sulphate in the manufacture of "milk" or "alabaster" glass, such a proposal being set forth in the United States Patent No. 210,331, issued November 26, 1878, to Joseph Kempner but, according to the process described in the United States patent just mentioned, barium sulphate is used with feldspar and fluorspar as additional ingredients of a batch also formed with soda, potash and sand and with which the then known so-called "ordinary decoloring" means and, furthermore, charcoal are also incorporated, all for the purpose and with the effect of producing a "milk" or "alabaster" glass. In such a process, the barium sulphate, in combination with the feldspar and fluorspar enters into reactions by reason of which the sulphate of the barium, the alumina of the feldspar and the fluorine of the fluorspar act together giving opacity to the "milk" or "alabaster" glass while, according to this invention in which barium sulphate is used as a batch ingredient, neither feldspar nor fluorspar is essential as an ingredient and carbon also is not essential, but is preferably not used for reasons hereinbefore stated.

In a process such as described in U. S. patent to Kempner mentioned, the now well-known and generally employed decolorizing agents for glass, such as selenium and manganese dioxide could not be used for the reason that their effect as decolorizing agents would be nullified in a batch of such a composition containing carbon.

When used according to the process of this invention barium sulphate has the still further advantage that in the manufacture of glasses using batches such as described, the barium sulphate serves to keep down or prevent the formation of scum which would otherwise tend to form and be formed upon the surface of the batch when melted.

The inventor has ascertained that in the manufacture and utilization of glass batches prepared and used in accord with the present invention and in which no carbonaceous or other reducing agent of similar effect is used, it will ordinarily be preferable for best results in practical operation, to use the barium sulphate in a proportion of about 4 pounds or somewhat less of the barium sulphate for each 100 pounds of sand or silica used in the batch. If too large a quantity of barium sulphate is used in a glass batch of the general character, such as has been described, the objectionable feature is likely to be encountered that a supernatent layer of molten sulphate material (usually termed "salt water" in glass factory parlance) may be formed upon the surface of the molten glass when the glass batch is melted.

Among the patent claims allowed is, a batch for glass production comprising a substantial proportion of barium sulphate as a primary ingredient and producing, when melted, a glass which is capable of being effectively decolorized by selenium and which solidifies to a clear transparent product.

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GLASS AND ITS MANUFACTURE. U. S. Patent 1,665,694. April 10, 1928. Elbert E. Fisher, Toledo, O., assignor of one-half to George W. Batchell, Toledo, O. Filed 4/6/27. An abstract follows:

In the copending application for United States patent, Serial No. 181,274, filed April 5, 1927, there is described and claimed a method of glass manufacture, a batch for use in such method and the glass produced, in which barium sulphate is used as one of the batch ingredients. While the use of barium sulphate as described, involves important practical advantages in processes of glass manufacture and in the properties of the glass which is produced, the inventor also made the further discovery that by the use of barium sulphide as hereinafter described certain additional advantages are obtained, together also with certain similar advantages which result in greater degree from the use of barium sulphide than when barium sulphate is used.

In the use of barium sulphide still larger quantities of barium may be introduced into the batch so as to impart predetermined desirable characteristics to the glass produced without causing objectionable formation of "salt water" on the batch when it is melted. By thus facilitating the employment of larger quantities of barium as a batch ingredient, the use of barium sulphide permits the practical and economical manufacture of glass in the production of which an even lower melting temperature may be employed than in the case of otherwise similar glasses which may be formed with the use of barium sulphate and also the use of barium sulphide according to my present invention permits the practical manufacture of glasses which are even more readily and satisfactorily worked by molding, blowing, drawing, pressing, or other usual glass-shaping operations and which may have even greater brilliance than glasses of otherwise like character formed with barium sulphate in the proportions in which the inventor has found it expedient to use it.

The following formulas are given as exemplifying the employment of this invention:

Improved formula of batch for making glass for bottles or jars, according to this invention: Sand, 100 pounds; Barium sulphide, 4 pounds; Soda ash, 35 pounds; Limestone, 18 pounds.

Window glass batch formula prepared according to my present invention: Sand, 100 pounds; Soda ash, 24 pounds; Barium sulphide, 10 pounds; Limestone, 26 pounds. (With or without) arsenious oxide, 1 ounce.

The inventor preferably employs a barium sulphide which does not contain more than about ten per cent of impurities, and the presence of barium carbonate (because of a higher temperature which it requires for its utilization by chemical recombination in a glass-forming batch when the batch is melted, as compared with the temperatures required for either barium sulphate or barium sulphide in otherwise similar batches) is, from a standpoint of maximum economy, disadvantageous and should therefore ordinarily be avoided so far as it is convenient and economical to restrict the formation and presence of the carbonate associated with the sulphite. The presence of some barium sulphate associated with the barium sulphide is not correspondingly disadvantageous but may, in fact, in some instances, be of direct advantage for the reason that barium sulphate possesses the desirable property of preventing or lessening the tendency to scum formation on the glass batch when melted.

This invention contemplates and embraces the use of barium sulphide whether it be supplied in the glass batch either in a relatively pure form or in a more or less crude form, such as when obtained by the method, of reducing ordinary commercial barium sulphate or barytes with coal or other suitable carbonaceous material.

But employing batches in accord with the present invention and which are substantially free from any quantities of carbonaceous or other reducing agents which would interfere with the decolorizing action of decolorizing agents such as selenium or its compounds, for example sodium selenite or barium selenide, or manganese dioxide. The inventor employs such decolorizing agents for satisfactory partial or complete decolorization of the glass produced.

One of the inventor's claims is a glass formed by melting a glass-forming batch containing barium sulphide as a primary ingredient and containing also silica and glass-forming compounds of sodium and calcium, said batch being capable, when melted, of being effectively decolorized by the action of selenium and possessing the property of solidifying in the form of substantially clear and transparent glass.

# Glass Factory Equipment and Supplies

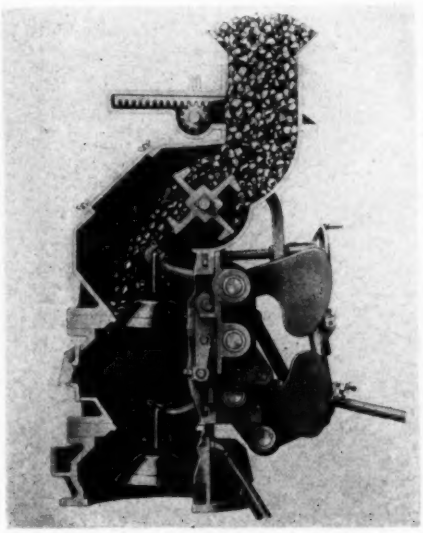
**Most of the information printed in this department comes direct from the manufacturers of the products described.**

## Wellman Mechanical Double-Bell Fuel Feed

A new bulletin, No. 90, descriptive of the Wellman Mechanical Double-Bell Fuel Feed, has been issued by the Wellman-Seaver-Morgan Company, Cleveland, Ohio. This is now standard equipment on the W-S-M type L gas producer. It is interchangeable with the type of mechanical feed supplied with Hughes Producers.

The new feed operates on an entirely different principle from any feed heretofore available. The illustration clearly shows its details.

Two bells are used, which lower and rise alternately, in passing the fuel into the producer. Their operation is mechanically automatic, requires but a fraction of a horsepower which is supplied by the producer motor, their action being so timed that one bell is open only when the other is closed.



MECHANICAL DOUBLE BELL FUEL FEED.

A continually gas tight closure is obtained by means of the spherical outer surface of the bells. The rate of feeding is regulated by the upper rotating, fingered vane-wheel, through the control traveling nut, screw and hand wheel. A shut-off valve section at the top of the feed, when closed, stops the flow of fuel from above.

Bituminous or anthracite coal, coke or lignite may be used in any size from slack up to 3 inch lumps.

The feed is made in two sizes, with capacities of 5,000 and 10,000 pounds of coal per hour.

## Cleaning Lenses

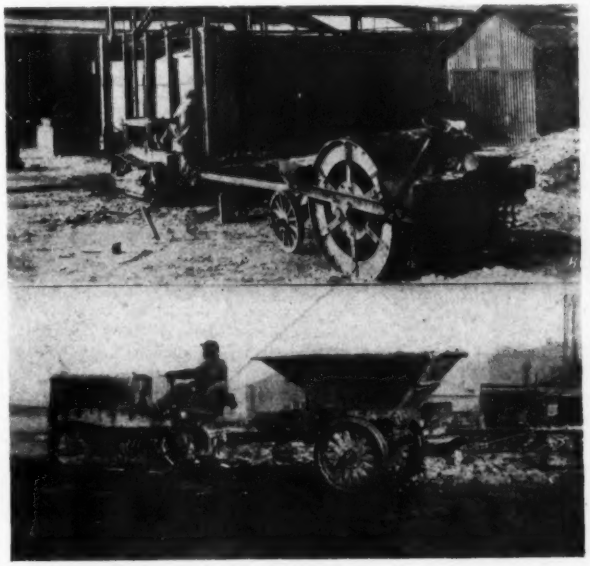
In a plant where ten thousand lenses are completed daily, it had been the custom to clean them by soaking in gasoline for eight hours, after which they were washed in whale oil soap. Even then it was often necessary to use alcohol to remove the last traces of the deposit. In addition to the soaking time required, this method called for considerable hand labor with consequent high costs. Then too, the constant presence of gasoline was a fire hazard that could not be blinked at.

In an effort to eliminate the need for gasoline and at the same time reduce costs, a method was developed for handling the work, that measured up to the company's greatest expectations. The procedure adopted was to place a wire basket of lenses, (about a thousand in a basket) in a solution of Oakite (made by the Oakley Chemical Company, Thames Street, New York) that is heated to a little less than boiling. The lenses are soaked for less than half an hour. Just before taking the basket out, it is agitated so that physical action will aid in completely removing the softened pitch and rouge. After rinsing, the lenses are spread out on a screen and dried with hot air.—*Oakite News Service.*

## Tractors Prove Useful in Glass Plant

The accompanying picture show two "Caterpillar" tractors that are kept busily at work at the plant of the American Window Glass Company at Jeannette, Pennsylvania.

These "Caterpillars" haul two-wheel, bottom-dump trailers for



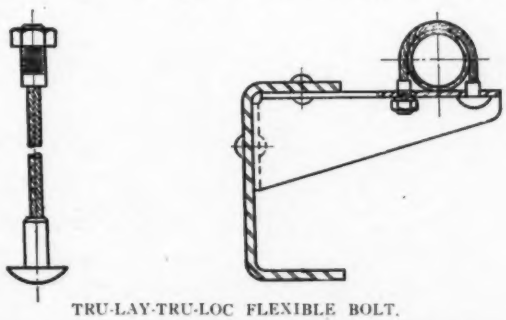
REDUCING HAULING COSTS.

transporting ashes and soot, and in various pushing and hauling operations have displaced large labor gangs.

Another important use is pulling a roller, for smoothing interplant roadways. A self powered machine to do this same work, according to the owners of the glass plant, would cost twice as much as "Caterpillar" and roller combined.

## New and Handy Flexible Bolt

A flexible bolt which it is believed will be useful in countless places in and around plants and mills of various kinds where ordinary U bolts are impracticable, has been brought out by the American Cable Company, 215 North Michigan avenue, Chicago,



TRU-LAY-TRU-LOC FLEXIBLE BOLT.

Ill. This Tru-Lay Tru-Loc flexible bolt is shown in the illustration and it is said has been used successfully on suspension brackets for overhead steam and water piping, as auxiliary hangers for power shafts, shackle bolts for temporary wall boxes, tanks, etc., for scaffolding and tackle and in other places where semi-flexible connections are necessary.

# The Glass World and What It Is Doing

## News of the Industry

### The Glass Blowers Appeal to President Coolidge

The glass bottle trade has been endeavoring for some time to secure an increase in the ad valorem rate of duty on high-grade perfume bottles based on the American valuation under Paragraph 218 of the present tariff act. All decorated or ornamented bottles under which this class of goods is classified, permits the President under the elastic provisions of this act, upon the recommendation of the Tariff Commission, to increase the duty 50 per cent if it can be conclusively proven by the bottle industry in the United States that it is unable to meet foreign competition.

As the bottle blower in Europe employed on this line of goods receives about $18 per week, while the stopper grinders' wages approximate $14 for the same period of time, with the balance of the employees around the plant receiving a much lower wage than mentioned above, it is obvious that the European manufacturer with this low cost of production can export his bottles to this country and sell them at a lower market price than the American glass manufacturer who is paying the American standard of wages. In view of this I feel sure there can be no question but that the cologne bottle part of the industry stands in dire need of some readjustment by the Tariff Commission to enable them to retain their business.

On April 30, 1927, a petition was presented to the President requesting him to direct the Tariff Commission to complete at once the investigation of the case submitted to that body on November 17, 1925. The President very promptly requested the Commission to go ahead with their investigation and report as soon as possible.

As no public hearing had been held since the above mentioned date, a committee composed of W. Jett Lauck, Economist, Washington, D. C., Secretary Harry Jenkins, Executive Officer Thomas B. Eames, and President James Maloney of the Glass Bottle Blowers' Association, on Monday, March 26, 1928, called on President Coolidge by appointment and presented a petition which called attention, among other things, to the fact that "importers and representatives of foreign factories during the past year have been absorbing an increasing proportion of domestic orders for perfume and toilet water bottles. We had hoped that action on our case would be taken before the opening of another trade season. As it is now, however, we shall soon again be confronted with foreign offerings which would even more seriously affect domestic industry than the devastating competition of last year.

"We are here as a labor group, because foreign competition is even a more serious matter to us than to the manufacturers. The manufacturers are in danger of serious financial loss, but when they can no longer meet foreign prices, they can reorganize their plants by turning to automatic machines and to the production of glassware other than perfume and toilet water bottles. This has already to a certain extent been done in several factories.

"But the glass bottle blowers have nowhere else to turn. There is no substitute work for them. Increasing foreign competition means complete loss to them of a profitable employment in which the majority have spent a long term of years in developing special skill and efficiency.

"Moreover, aside from the personal aspect of the matter, or, its bearing upon our members individually as well as upon our organization, we do not think it should be permitted from the standpoint of public policy. It is not right to allow a skilled craft of this character to be destroyed because of failure to give to it adequate protection under our tariff laws which have for one of their main purposes the safeguarding of the wages and standards of living of American labor.

"Under these conditions, we would, therefore, be sincerely grateful if you will request the Tariff Commission temporarily to concentrate a larger force upon our investigation and bring it to a conclusion within a short time."

The Committee was cordially received, the President graciously informing them that he would again take the matter up with the Tariff Commission at once and see if the matter could not be expedited, a public hearing obtained and a final decision rendered.

### Your Last Chance to Join the European Tour

Many ceramists from other branches of the industry besides glass have made their reservations and assured themselves of not missing this delightful educational, refreshing and broadening trip.

From our own branch, an additional number of prospective tourists have made arrangements to take the Ceramic Tour abroad and visit England and the Continent, including: France, Holland, Germany, Czechoslovakia. They are: Clarence E. Fulton, Pittsburgh Plate Glass Company, Creighton, Pa.; J. F. Early, Akro Agate Company, Clarksburg, W. Va.; C. R. Essick, Pennsylvania Optical Company, Reading, Pa.; T. S. and Mrs. Curtis, Vitrefrax Company, Los Angeles, Cal., and Ralph O. Smith, Salem Glass Works, Salem, N. J.

A central committee of The Glass Masters of France have written to R. C. Purdy, Secretary of the American Ceramic Society, regarding the proposed visits of those taking in the Ceramic tour to several establishments, as follows:

1—Glaceries of Saint Gobain at Tourotte, near Compeigne.

2—Lalique Establishment at Paris.

3—Cristalleries, or to Baccarat, or to Saint Louis, in the East of France.

In England a large Reception Committee has been appointed to look after the interests of the visitors during their stay in that country. The membership of the Committee includes numerous refractory and glass men. Among the latter are:

Professor W. E. S. Turner, D.Sc., M.Sc., Secretary, Society of Glass Technology.

W. A. Bailey, Rockware Glass Syndicate, Ltd.

J. Connolly, Treasurer, Society of Glass Technology.

H. E. Hailwood, Hailwood & Ackroyd, Ltd.

Colonel S. C. Halse, C.M.G., Past-President, Society of Glass Technology.

Sir Sydney Henn, M.P., Chairman, Glass Manufacturers' Federation.

W. Butler, Glass Works Manager.

T. C. Moorshead, Past-President, Society of Glass Technology.

W. T. Munro, The British Thomson-Houston Co., Ltd., Master of the Glass Sellers Company and Glaziers Company.

F. G. Orme, Secy., Messrs. James Powell & Sons Glass Works.

A. Marriott Powell, Director, James Powell & Sons Glass Works.

F. Redfern, John Lumb & Co., Castleford.

H. Webb, Chairman, British Flint Glass Manufacturers' Association.

W. F. J. Wood, C.B.E., B.Sc., President, Glass Research Delegacy.

W. G. P. Hutchenson, Art Director, Messrs. James Powell & Sons Glass Works.

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### German and English Technologists Will Meet Jointly at Aachen

The German Society of Glass Technology will hold its ninth meeting at Aachen, jointly with the English Society of Glass Technology on May 22-24, 1928.

The following is the official program:

Tuesday, May 22, 9 A. M. Reception at the City Hall of Aachen, by the Mayor.

10 A. M. Visit to City Hall, the Cathedral and the Treasury.

10 A. M. Sessions of Special Committees:

I. Physics and Chemistry of Glass, Dr. K. Scheel.

II. Furnace Construction and Heat Economy, F. Weckerle.

III. Glass Making Machinery, Dr. W. Wendler.

11 A. M. Session of the Executive Committee.

3 P. M. Joint Meeting of Special Committees, with English representatives,

a. Definition and Measurement of Physical Constants of Glass (Limited to Weathering, Viscosity and Heat Expansion). Dr. M. Thomas, Dr. S. English.

b. Relationship between Physical Properties of Molten Glass and Workability by Machinery. F. W. Adams, Dr. G. Gehlhoff.

c. New Progress in the Field of Refractory Materials with special reference to the glass industry. W. J. Rees, Dr. W. Miehr.

MAIN SESSION

1. The Glass Furnace as Heat Producer, Dr. D. Aufhäuser, Hamburg.

2. The Heat Expansion of Glass and the Question of the Determination of the Annealing Temperatures. Dr. W. E. S. Turner, Sheffield.

3. The Crystallization Rapidity of Soda-Lime-Silicate Glasses. Dr. E. Zschimmer, Karlsruhe.

4. Expansion and Tension Tests of Refractory Materials for Glass Works. J. F. Hyslop, R. F. Proctor, H. C. Biggs.

5. The Physical Properties of Clays. Dr. G. Gehlhoff, Berlin.

6. The Influence of Cullet on Glass Making. Dr. W. E. S. Turner, Sheffield.

7. The Gas and Water Contents of Glasses. Dr. H. Salmang, Aachen.

8. The Annealing of Glass in Practice. E. A. Coad-Pryor, London.

On Wednesday May 23 a dinner will be presented to the members by the Saint Gobain Plate Glass Company, the Stolberg Plate Glass Works and the Bicheroux Plate Glass Works of Herzogenrath.

On May 24, visits to the Plate Glass Works of Stolberg (St. Gobain Company) or of the Plate Glass Works of Herzogenrath (Bicheroux Process).

## Contest in Design by Glass and Ceramic Artists

Theodore Lenchner, chairman of "Art in Industry Committee" of the American Ceramic Society, has been pointing out that a serious attempt is being made by the society to prove that ceramic products, whether of glass, clay or enamel, if properly designed and decorated, will prove of inestimable value to the manufacturer and that it will bring its own reward. He speaks of ceramic products which are capable of being produced under mass production conditions.

The "Art in Industry Committee" is now functioning and has proposed a competitive contest in which all ceramic product manufacturers have been asked to submit a set of specifications involving their own product. These specifications are to state the product which they wish to see designed, its use, its dimensions, how manufactured and its limitations of manufacture under production conditions.

After the specifications are in the hands of the committee, a competitive contest is proposed in which all designers, decorators, students of art schools, and artists are asked to submit designs for the products whose manufacture they are most familiar with. These designs are to be submitted to two juries, one passing on the practicability of the design and the other selecting from the practical designs, those possessing the most merit. An effort will then be made to market the prize design in each division, the highest bidder obtaining it and the sum so received will go to the designer.

It is desired that all specifications reach the committee by June 1 and should be sent to the chairman, Theodore Lenchner, care the Roessler & Hasslacher Chemical Company, 709 Sixth avenue, New York.

The personnel of the committee is as follows: Chairman, Theodore Lenchner, of the Roessler & Hasslacher Chemical Company; Miss C. K. Nelson, N. Y. State School of Clayworking and Ceramics; Miss Ruth Canfield, Henry St. Settlement, N. Y.; H. R. Bacher, Rock Tavern, N. Y.; Ede F. Curtis, Wayne, Pa.

## Polished Plate Glass Production for First Quarter

Figures compiled by P. A. Hughes, secretary of the Plate Glass Manufacturers of America, show that the production of polished plate glass for the month of March, 1928, was 11,297,173 square feet, an increase of 1,204,288 square feet over the February production. The total production for the first quarter of 1928 was 29,595,355 square feet. These figures compare with 11,641,036 square feet produced in March, 1927, and a total of 29,914,633 square feet for the first quarter of 1927.

## Report of A. S. A. B. Glass Container Committee

F. C. Magness, chairman of the Glass Container Committee of the Atlantic States Advisory Board, has made the following report for the second quarter of 1928:

The estimated car requirements will be 2,400 cars, which is an increase of 3 per cent over the second quarter of 1927 and about 17 per cent more than for the first quarter of 1928.

## First Quarter Construction Ahead of 1927

Construction contracts to the amount of $592,567,000 were awarded last month in the 37 States east of the Rocky Mountains, according to F. W. Dodge Corporation. The above figure covers about 91 per cent of the total construction of the country. Last month's total was the highest monthly contract total on record for the 37 States since June 1927. There was an increase of 27 per cent over the total for February of this year, but there was a drop of 5 per cent from the March 1927 record.

Last month's record brought the total amount of new construction started since the first of this year in these states up to $1,485,067,000, being an increase of 6 per cent over the amount started in the first quarter of last year. In addition to being ahead of last year's first quarter record it was the highest first quarter ever recorded for the 37 States.

## Refractories Institute to Have Non-Technical Discussion

The annual meeting of the American Refractories Institute will be held at The Greenbrier, White Sulphur Springs, Tuesday, May 8. The important feature will be the discussion of a select list of specifications used by consumers at the present time for the purchase of refractories. An effort is being made to have a well balanced attendance between the consuming and producing interest. With such a representation of those interested it is planned to discuss in detail the various phases of specifications in a non-technical way so as to indicate their merits and faults.

A cordial invitation to attend this meeting is extended to everyone interested in such specifications. The Refractories Institute will welcome suggestions and any specifications offered for open discussion. For further particulars address the Secretary, 2202 Oliver Building, Pittsburgh, Pa.

## X-Rays in Ceramics

At a meeting of the Pittsburgh Section of the American Ceramic Society held on April 10, Dr. Wm. McCaughey of Ohio State University spoke on the uses of the X-rays in ceramics. Dr. McCaughey described both the applications and the limitations of the X-ray camera in the field of silicate chemistry. A large number of ceramists from Western Pennsylvania and Eastern Ohio were present.

On May 14 the Pittsburgh section will hold a joint meeting with the Management Section of the American Society of Mechanical Engineers.

## W. L. Monro Will Address Mechanical Engineers' Society

W. L. Monro, president of the American Window Glass Company, will make the principal address to the American Society of Mechanical Engineers at a dinner, to be held in Pittsburgh on May 16, in connection with the society's spring meeting.

## Correction

Owing to a printer's error, a word was omitted from the French name of the Saint-Gobain Plate Glass Company, which appeared in the footnote on page 75 of the April number. The correct name is Manufactures Des Glaces et Produits Chimiques de Saint-Gobain, Chauny et Cirey.

## Selenium Prices Reduced

Formal notification has been made of the reduction of selenium prices from $2.05-2.15 to $1.95-2.00, according to quantity purchased.

## Tariff Commission to Investigate Potassium Nitrate

An investigation was ordered on April 19 to determine the domestic and foreign costs of producing refined potassium nitrate.

## Trade Activities

**The Pennsylvania Bottle Company,** Sheffield, Pa., started fires in their new tank on April 11.

**The American Plate Glass Corporation** resumed manufacturing operations at their Durant City plant early in April.

**The Gill Glass Products Company,** Philadelphia, has been granted a Delaware charter to deal in glass and glassware of all kinds. The capital is $100,000.

**Frank E. Dugan,** manager of the Toledo branch of the Pittsburgh Plate Glass Company, has been made manager of the Kansas City, Mo. branch.

**Virginia Mirror Company,** Martinsville, Va., have started work on an addition to their plant, which will be used for the manufacture of mirrors, mirror frames, etc.

**The United States Tariff Commission** at Washington on April 11 confirmed the nomination of Frank Clark of Florida to be a member of the Tariff Commission.

**The Pennsylvania Wire Glass Company's** plant at Dunbar, Pa., resumed operations on April 17, with a new tank recently completed. About 200 men returned to work.

**Laclede-Christy Clay Products Company,** whose offices for ten years have been in the Railway Exchange Building, St. Louis, Mo., have leased the top floor in the new Ambassador Building.

**W. J. Smith,** general manager of the Australian Glass Manufacturers Company, Ltd., Spottswood, Australia, has been visiting the Pennsylvania glass district and other sections of the country during the past few weeks.

**The Pittsburgh Plate Glass Company** recently began shipping plate glass by barge down the Allegheny River from Ford City to the Creighton plant. A large saving is made by the adoption of this means of transportation.

**The Central States Flat Glass Company,** Sandusky, Ohio, are installing Fourcault drawing equipment, and it is expected that operations will begin within a few weeks. It is said that they are also planning to manufacture non-shatterable glass.

**The Brown Instrument Company** of Philadelphia, Pa., has secured larger quarters for its Pacific Coast branch in the Westinghouse Electric Building, 420 South San Pedro Street, Los Angeles, Cal. Stanley F. Godfrey is manager of this branch.

**The Ravenswood Glass Novelty Company,** of Fairmont, W. Va., has been granted a charter with a capital of $25,000. The incorporators are: D. Rector, W. C. Clark, C. W. Turnbull, C. E. Mason, all of Ravenswood, and L. E. Alley, of Salem, W. Va.

**The McKee Glass Company,** Jeannette, Pa., experienced a break in their 95 ton tank on April 1. Hot repairs were made, and operations resumed. A new modern tank that will greatly increase the production capacity of the plant is under construction.

**Pittsburgh Lamp and Artcraft, Inc.,** 227 Chess Street, Pittsburgh, Pa., started operations in March, manufacturing floor, table and novelty lamps and gift articles. O. A. Ross is president of the Company, F. W. Snedden, vice-president, and W. Z. Heinsohn, secretary and treasurer.

**The United States Glass Company,** Pittsburgh, Pa., through President E. L. Slick, report that their factories in the Pittsburgh district are operating at an average rate of approximately 80 per cent of capacity. The Company is adding a line of packers' goods, such as jars, etc.

**The American Window Glass Company** established a new record in production at their Jeannette, Pa., plant during the first week in April when an average of 100.2 boxes were made every twenty-four hours. There are twelve cylinder drawing machines in this plant, capable of making glass cylinders almost 45 feet in length and up to 35 inches in diameter.

**Dr. Fritz Eckert** of the Technischen Hochschule, Berlin, Germany, sailed for his home country on April 5 with Mrs. Eckert, after a visit of several months to this country. In February he addressed the Glass Division at the Atlantic City convention. He spent much time visiting many technical institutions and glass and ceramic factories throughout the middle west and east, being particularly interested in the glass industry.

**The General Electric Company's** sales for the first three months of 1928, according to President Gerard Swope, amounted to $71,640,790 as compared with $72,474,474 for the corresponding period last year. Profit available for dividends on common stock for the first quarter of 1928 was $11,261,842 compared with $11,028,143 for the same three months last year.

**The Fostoria Glass Company,** Moundsville, W. Va., early in April elected C. B. Roe as president of the company to succeed the late W. A. B. Dalzell. Mr. Roe has been closely associated with Mr. Dalzell in the management of the company during the past quarter of a century. W. W. Holloway of Wheeling, W. Va., was elected to fill the vacancy on the board caused by the death of Mr. Dalzell. W. F. Dalzell was elected vice-president and general manager. A. W. Koenemund is now secretary.

**Golding Sons' Company** and **Erwin Feldspar Company,** through V. V. Kelsey, sales manager, announce that the new feldspar mill at Spruce Pine, N. C., was placed in operation during the second week in April. The new mill is located near the company's extensive mines in order to give the trade better service. There are no feldspar deposits or mines in Tennessee. Feldspar shipped from the company's mills at Erwin, Tenn., has always been supplied from their North Carolina mines. Operating and shipping activities will, however, continue at the Tennessee mills.

**The Standard Plate Glass Company** at its annual meeting at Pittsburgh on April 19, elected the following officers for the ensuing year: President, R. B. Tucker; vice-president, J. D. Watson; secretary, Joseph Heidenkamp, Jr.; treasurer, J. R. Eckler. The following directors were elected: S. B. Congdon; Charles W. Dahlinger; Frank R. Frost; Joseph Heidenkamp; Joseph Heidenkamp, Jr.; L. A. Hippach; George A. Kim; Nelson R. Perin; W. B. Purvis; F. O. Reinhart; Louis R. Schmertz; A. C. Troutman; R. B. Tucker; H. K. Watson and J. D. Watson.

**H. S. Wherrett,** formerly vice-president of the Pittsburgh plate Glass Company, has been elected president to succeed the late Capt. Charles W. Brown. H. B. Higgins has been advanced to the position occupied by Mr. Wherrett. W. L. Clause was re-elected chairman of the board as were also the remaining directors including Edward Pitcairn, C. M. Brown, Raymond Pitcairn, Ludington Patton, H. A. Galt, R. B. Mellon, R. L. Clause and J. H. Heroy. Officers re-elected were Messrs. Brown, Galt, Patton and Clause, vice-presidents; C. S. Lamb, secretary, and Edward Pitcairn, treasurer.

**The American Association of Flint and Lime Glass Manufacturers** held the first of a series of quarterly meetings which have been planned for, at the Roosevelt Hotel, Pittsburgh, on April 10. C. M. Rodefer of the Rodefer Glass Company was in charge of the meeting. F. C. Flint of the Hazel-Atlas Glass Company, made an interesting address covering the art of making glass from its earliest known history up to the present. At this meeting a resolution of sympathy was adopted to be sent to the widow of the late William A. B. Dalzell of the Fostoria Glass Company, Moundsville, W. Va., whose death occurred in March.

## Industrial Publications

**Pyrometers of Recording, Indicating and Automatic Controlling Types.** Catalogue L-28. Wilson-Maeulen Company, 385 Concord Avenue, New York. This is a 40-page pocket-size catalogue with type and illustrations reduced photolithographically. In it is a large amount of information regarding the Wilson-Maeulen products, including the Tapalog and other types—the automatic electrical cold junction compensator; the mono-pivot pyrometer indicator; high resistance master portable indicator; two-pivot indicators; pyrometer switches; pyods (thermocouples) nork thermocouples; platinum, platinum-rhodium thermocouples and accessories; automatic temperature control for oil, gas and electric furnaces;

electric resistance-bulbs; indicating thermometers; W-M resistance thermometer bulbs.

**The Federal Specifications Board,** Washington, D. C., has issued a report on the proposed revision of the United States Government Master Specification for Industrial Thermometers. It is suggested by Dr. George K. Burgess, Chairman of the Board, that persons interested obtain copies of this Specification and send in any comments or suggestions as to changes which may be thought to be desirable in the Specification to the Board not later than May 31st, for the consideration of the Technical Committee in charge of this subject.

**Trade Information Bulletin No. 532**, Bureau of Foreign and Domestic Commerce, in an article on German Chemical Development in 1927, states that the estimated production of soda ash for the latest year available is nine hundred thousand metric tons.

## Recent Deaths

### Arthur A. Houghton

Arthur A. Houghton, former president of the Corning Glass Works at Corning, N. Y., and a brother of Alanson B. Houghton, Ambassador to Great Britain, died at his home in New York on April 19 at the age of 61 years. His wife, and a daughter, Mrs. Allen G. Rhinehart, and a son, Arthur A. Houghton, Jr., survive. Mr. Houghton was born in Brooklyn, N. Y. He was the grandson of Amory Houghton, pioneer in the glass industry in this country. The family was of English origin, and settled in New England in 1636. Mr. Houghton was associated with his father and brother in the management of the glass company previous to his father's death. A few years ago, he retired as president of the Corning Glass Works. He was a man of wide business, social and political interests, and a member of numerous clubs.

## Coming Meetings

**The American Ceramic Society's** European tour will cover the period from May 19 to July 5, 1928, and will include visits to England, Germany, Czechoslovakia, France and Holland. The 1929 annual convention of the Society will be held in Chicago.

**The National Lighting Equipment Exhibition** of the Artistic Lighting Equipment Association will be held at the Hotel Sherman, Chicago, Ill., June 11 to 16.

**The American Refractories Institute** will hold its annual meeting at the Greenbrier, White Sulphur Springs, W. Va., on Tuesday, May 8.

**The National Lime Association** will hold its annual convention at the Belmont Hotel, New York, May 23 and 24.

**The Canadian National Clay Products Association** will hold its 26th annual convention at Montreal, June 11, 12 and 13.

**The American Society of Mechanical Engineers** will hold its spring meeting at Pittsburgh, May 15-17.

## Inquiries Received

*For further information address* THE GLASS INDUSTRY

409. We have an inquiry from abroad for the names and addresses of manufacturers of machinery for making pressed glassware, tumblers and blown glassware, lamp chimneys, also molds for glassware and paste molds, glass feeders for automatic machines, cracking-off and remelting machine for goblets, remelting machines for pressed glassware. Also manufacturers of glass decolorizers and colors for glass decoration. They would also like catalogs of glassware, especially table ware, illuminating ware and construction glass such as tiles, etc., which could be exported from United States and sold in Latin America. (April 11.)

410. I would like to have information in reference to glass cylinders of all sizes. Can you give me the names of manufacturers? (April 2.)

411. We have an inquiry from Russia for literature, prices and samples of special glasses which admit ultraviolet rays. (April 5.)

412. We desire to obtain, for experimental purposes, a few perfectly round and polished agate or glass balls of diameter between one-half to five-eighths of an inch. We are not so much concerned about the exact diameter as we are about holding the diameter to close limits in a given specimen. Can you advise where such balls may be obtained? (April 11.)

413. Can you give us information as to where a machine for forming glass into solid spheres, such as marbles, etc., can be obtained. We are also interested in machines which would grind such a blank into a true sphere. (April 13.)

414. We are interested in the acid polishing of glass and would like to receive information on that subject. (March 27.)

415. We are endeavoring to locate a source of supply for colored smalt powdered glass, but up to the present time have been unable to locate same. (April 17.)

416. Our plans are being made to erect a plant here in Houston this summer to manufacture glass bottles and jars. Any information, catalogues or literature you can have sent to us will be appreciated. (From George Leland & Compny, 1224 Esperson Building, Houston, Texas.) (April 17.)

417. Please send us a list of glass manufacturers who can supply molded glass pieces similar to those used as bases for table lamps. (April 19.)

## What the World Wants

*Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C.*

Brazil: 30458, fine cut and crystal glassware.
Canada: 30460, job lot glassware.
Argentina: 30526, table glassware.
Porto Rico: 30579, table, pressed and blown glassware.

## Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, APRIL 20, 1928.
Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

| | Bid | Asked | Last |
|---|---|---|---|
| American Window Glass Machine, Com. | .. | .. | 22 |
| American Window Glass Machine, Pfd. | .. | .. | 45 |
| American Window Glass, Pfd. | 87 | 88½ | 88 |
| United States Glass | 12 | 12¼ | 12½ |
| Pittsburgh Plate Glass, Com. | 222 | .. | 226 |
| Standard Plate Glass, Com. | .. | .. | 47⅞ |
| Standard Plate Glass: | | | |
| Preferred cumulative | .. | .. | 20⅛ |
| Prior preferred | .. | .. | 33 |

TOLEDO, O., APRIL 20, 1928

| | Bid | Asked | Last |
|---|---|---|---|
| Owens Bottle, pfd. | 115 | .. | 115 |
| Libbey-Owens Sheet Glass, Com. | 114 | 116 | 115 |
| Libbey-Owens Sheet Glass, Pfd. | 115 | 117 | 116 |

WHEELING STOCK EXCHANGE, APRIL 20, 1928

| | Bid | Asked | Last |
|---|---|---|---|
| Hazel-Atlas | 86½ | .. | 87 |
| Imperial | .. | .. | 72 |
| Fostoria | .. | .. | 208 |
| Central | .. | .. | 75 |
| Jefferson, Pfd. | .. | .. | 96 |


## READERS WANTS AND OFFERS

**For Sale:** CULLET of all Descriptions
Free from Caps, Wires, etc.
GEORGE F. BAUMANN, Dealer,
1110 Carroll Street, Brooklyn, New York.
Carloads Ready for Immediate Shipment.

**WANTED, BACK NUMBERS** of THE GLASS INDUSTRY, January, 1923. Also November, 1927. Premium offered. Address, 50 Church St., New York.

## Current Prices of Glass-Making Materials

April 20, 1928

Quotations furnished by various producers, manufacturers and dealers

| | | Carlots | Less Carlots |
|---|---|---|---|
| **Acid** | | | |
| Citric (dom.) | lb. | .46 | .46 |
| Hydrochloric (HCl) 20° tanks, per 100 lb. | | .. | 1.10 |
| Hydrofluoric (HF) 60% (lead carboy) | lb. | .. | .13½ |
| 52% and 48% | lb. | .10 | .10-.11½ |
| Nitric ($HNO_3$) 38° carboy ext. Per 100 lb. | | 5.50 | 5.75 |
| Sulphuric ($H_2SO_4$) 66° tank cars | ton | 15.50 | .. |
| Tartaric | lb. | .38 | .38-.39½ |
| Alcohol, denatured | gal. | .. | .53 |
| Aluminum hydrate (Al $(OH)_3$) | lb. | .04½-.05 | .05½-.06 |
| Aluminum oxide ($Al_2O_3$) | lb | .. | .07 |
| Ammonium bifluoride ($NH_4$) FHF | lb. | .. | .21 |
| Ammonia water ($NH_4OH$) 26° drums | lb. | .03 | .03¼ |
| Antimony, metallic (Sb) | lb. | .. | .10½-.10¾ |
| Antimony oxide ($Sb_2O_3$) | lb. | .. | .14 |
| Antimony sulphide ($Sb_2S_3$) | lb. | .. | .13 |
| Arsenic trioxide ($As_2O_3$) (dense white), 99% | lb. | .04 | .04¼-.04½ |
| Barium carbonate ($BaCO_3$) | | | |
| Precipitated | ton | 57.50 | 60.00 |
| Natural, powdered, imported | ton | 45.00 | 50.00 |
| Barium hydrate ($Ba(OH)_2$) | lb. | .. | .. |
| Barium nitrate ($Ba(NO_3)_2$) | lb. | .08¼ | .08½ |
| Barium selenite ($BaSeO_3$) | lb. | .. | .. |
| Bone ash | lb. | .05 | .05½ |
| Borax ($Na_2B_4O_7 10H_2O$) | lb. | .03¾ | .04-.04½ |
| Boric acid ($H_3BO_3$) | lb. | .08-.08¼ | .08¼-.08¾ |
| Refined | lb. | .08-.08¼ | .08½-.08¾ |
| Cadmium sulphide (CdS)— | | | |
| Red | lb. | .. | 1.20 |
| Orange | lb. | .. | 1.10-1.25 |
| Yellow | lb. | .. | 1.20-1.40 |
| Chromium oxide ($Cr_2O_3$) | lb. | .27 | .28 |
| Cobalt oxide ($Co_2O_3$) | | | |
| In bbls. | lb. | .. | 2.10 |
| In 10 lb. tins | lb. | .. | 2.20 |
| Copper oxide | | | |
| Red ($Cu_2O$) | lb. | .. | .30 |
| Black (CuO) | lb. | .. | .25-.30 |
| Black prepared | lb. | . | .30 |
| Cryolite ($Na_3Al\ F_6$) Natural Greenland Kryolith) | lb. | .09 | .10-.10½ |
| Artificial or Chemical | lb. | | .09½ |
| Epsom salts ($MgSO_4$) (imported) Per 100 lb. | | .. | 1.15-1.30 |
| Feldspar— | | | |
| 100 mesh | ton | 13.00-20.00 | 15.50-22.00 |
| 80 mesh | ton | 11.75 | 14.50 |
| 40 mesh | ton | 11.00 | 13.50 |
| Fluorspar ($CaF_2$) domestic, ground, 95-98% (max $SiO_2$, 2½%) | | | |
| Bulk, carloads, f.o.b. mines | ton | 32.50 | .. |
| In bags or barrels | ton | 36.50 | 41.50 |
| Formaldehyde | lb. | .08 | .08½ |
| Graphite (C) | lb. | .. | .04-.07 |
| Iron oxide— | | | |
| Red ($Fe_2O_3$) | lb. | .. | .03¼-.07 |
| Black (FeO) | lb. | .03½ | .. |
| Kaolin (f.o.b. mine) | ton | 9.00 | .. |
| English, lump, f.o.b. New York | ton | 14.50 | 24.50 |
| Kryolith (see Cryolite) | | | |
| Lead chromate ($PbCrO_4$) | lb. | .. | .. |
| Lead oxide ($Pb_3O_4$) (red lead) | lb. | .08⅝-.09½ | .09½-.09¾ |
| Litharge (PbO) | lb. | .07⅝-.08½ | .08½-.08¾ |
| **Lime—** | | | |
| Hydrated (Ca $(OH)_2$) (in paper sacks) | ton | 11.50-12.50 | .. |
| Burnt (CaO) ground, in bulk | ton | 8.00 | .. |
| Burnt, ground, in paper sacks | ton | 10.00-11.00 | .. |
| Burnt, ground, in 280 lb. bbls. | Per bbl. | 2.15 | 2.30 |
| Limestone ($CaCO_3$) | | 2.00 | .. |
| Magnesia (MgO)— | | | |
| Calcined, heavy (in bbls.) | lb. | .06 | .07 |
| light (in bbls.) | lb. | .. | .23 |
| extra light (in bbls.) | lb. | .. | .37 |
| Magnesium carbonate ($MgCO_3$) | lb. | .06 | .08 |
| Manganese 85% ($MnO_2$) | lb. | .04 | .04½ |
| Nickel oxide ($Ni_2O_3$), black— | | | |
| for nickel content | lb. | .. | .35 |
| Nickel monoxide (NiO), green— | | | |
| for nickel content | lb. | .. | .35 |
| Plaster of Paris, bags | ton | .. | 23.00 |
| Potassium bichromate ($K_2Cr_2O_7$)— | | | |
| Crystals | lb. | .08½ | .09 |
| Ground | lb. | .11 | .12 |
| Potassium carbonate— | | | |
| Calcined ($K_2CO_3$) 96-98% | lb. | 06⅝ | .07⅛ |
| Hydrated 80-85% | lb. | .06 | .06½ |
| Potassium chromate ($K_2CrO_4$) | lb. | .. | .28 |
| Potassium hydrate (KOH) (caustic potash) | lb. | .07⅛ | .08 |
| Potassium nitrate ($KNO_3$) (gran.) | lb. | .. | .05¾-.06 |
| Potassium permanganate ($KMnO_4$) | lb. | .15 | .15½ |
| Powdered blue | lb. | .. | .24-.26 |
| Rochelle salts, bbls. | lb. | .. | .23 |
| Rouge | lb. | .. | .. |
| Rutile ($TiO_2$) powdered, 95% | lb. | .15-.20 | .20-.25 |
| Salt cake, glassmakers ($Na_2SO_4$) | ton | 22.00 | .. |
| Selenium (Se) | lb. | .. | 1.95-2.00 |
| Silver nitrate ($AgNO_3$) | oz. | .. | .39½-.41½ |
| Soda ash ($Na_2CO_3$) dense, 58%— | | | |
| Bulk, on contract | Flat per 100 lb. | 1.22½ | .. |
| In barrels | Per 100 lb. | 1.55-1.57½ | 2.40 |
| In bags | Per 100 lb. | 1.37½-1.40 | .. |
| Spot orders. .02½-.05 per 100 lbs. higher | | | |
| Sodium bichromate ($Na_2Cr_2O_7$) | lb. | .07 | .07¼ |
| Sodium hydrate (NaOH) (caustic soda) | Per 100 lb. | 3.35 | .. |
| Sodium nitrate ($NaNO_3$)— | | | |
| Refined (gran.) in bbls. | lb. | .03¾ | .04½ |
| 95 per cent | Per 100 lb. | 2.32½ | 2.75 |
| Sodium selenite ($Na_2SeO_3$) | lb. | .. | 2.35 |
| Sodium fluosilicate ($Na_2SiF_6$) | lb. | .04¾ | .05½ |
| Sodium uranate ($Na_2UO_4$) Yellow or Orange | lb. | .. | 1.25 |
| Sulphur (S)— | | | |
| Flowers, in bbls. | Per 100 lb. | 3.45 | 3.80-4.00 |
| Flowers, in bags | Per 100 lb. | 3.10 | 3.45-3.65 |
| Flour, heavy in bbls. | Per 100 lb. | 2.85 | 3.20-3.40 |
| Tin chloride ($SnCl_2$) (crystals) | lb. | .39 | .41 |
| Tin oxide ($SnO_2$) in bbls. | lb. | .. | .56 |
| Uranium oxide ($UO_3$) (black, 96% $U_3O_8$) 100 lb. lots | lb. | .. | 1.25-2.25 |
| Zinc oxide (ZnO) | lb. | .06½-.08½ | .12 |
| Zircon | | | |
| Granular (Milled .005-.02c higher) | | .07 | .07½-.08 |
| Crude, Gran. (Milled .005-.02c higher) | | .03½ | .04-.05 |

## Monthly Summary of United States Foreign Commerce in Glass

### EXPORTS

**Corrected to March 1, 1928**

| | February 1927 Quantity | February 1927 Value | February 1928 Quantity | February 1928 Value | Two Months Ending February 1927 Quantity | Two Months Ending February 1927 Value | Two Months Ending February 1928 Quantity | Two Months Ending February 1928 Value |
|---|---|---|---|---|---|---|---|---|
| Glass and glass products (total) | ..... | $619,497 | ..... | $717,473 | ..... | $1,323,674 | ..... | $1,434,006 |
| Plate and window glass— | | | | | | | | |
| Window glass, common, box 50 sq. ft. | 646 | 3,710 | 1,471 | 9,360 | 3,007 | 18,570 | 2,267 | 15,193 |
| Plate glass, unsilvered, sq. ft. | 132,544 | 32,810 | 138,073 | 50,788 | 245,883 | 63,689 | 230,400 | 85,722 |
| Other window and plate glass lbs. | 226,710 | 25,868 | 416,531 | 46,031 | 641,611 | 55,180 | 624,682 | 78,964 |
| Glass containers (bottles, vials and jars) | ..... | 192,835 | ..... | 233,323 | ..... | 387,305 | ..... | 489,137 |
| Table glassware, plain | ..... | 97,014 | ..... | 106,622 | ..... | 220,971 | ..... | 203,985 |
| Table and other glassware, cut or engraved | ..... | 11,813 | ..... | 8,332 | ..... | 20,154 | ..... | 18,206 |
| Lamp chimneys and lantern globes lbs. | 188,672 | 34,795 | 164,809 | 34,731 | 393,341 | 82,998 | 353,955 | 69,132 |
| Globes and shades for lighting fixtures lbs. | 124,146 | 50,456 | 124,788 | 48,156 | 283,242 | 102,461 | 242,644 | 89,361 |
| Chemical glassware lbs. | 7,970 | 9,967 | 18,950 | 13,358 | 24,619 | 24,043 | 70,106 | 30,537 |
| Electrical glassware, except for lighting lbs. | 257,152 | 24,012 | 665,621 | 40,467 | 428,125 | 48,224 | 872,619 | 69,518 |
| Other glassware | ..... | 136,217 | ..... | 126,305 | ..... | 300,079 | ..... | 284,251 |

### IMPORTS

**Corrected to March 1, 1928**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Glass and glass products | ..... | $1,271,635 | ..... | $1,102,799 | ..... | $2,656,840 | ..... | $2,032,482 |
| Cylinder, crown and sheet— | | | | | | | | |
| Unpolished— | | | | | | | | |
| Weighing less than 80 pounds per case dut. lb. | 4,143,118 | 108,194 | 2,462,145 | 75,421 | 7,784,543 | 206,963 | 5,356,104 | 163,511 |
| Weighing 80 pounds or over per case dut. lb. | 3,496,155 | 155,197 | 2,509,784 | 122,076 | 6,977,493 | 368,594 | 4,686,118 | 233,073 |
| Bent, ground, beveled, colored, painted, etc., and polished dut. | ..... | 29,063 | ..... | 42,986 | ..... | 72,404 | ..... | 74,025 |
| Plate glass— | | | | | | | | |
| Polished, unsilvered dut. sq. ft. | 1,030,992 | 364,998 | 1,275,218 | 269,689 | 2,388,052 | 862,402 | 2,083,777 | 447,798 |
| Other dut. sq. ft. | 68,389 | 16,928 | 112,181 | 22,761 | 179,269 | 44,103 | 201,987 | 46,638 |
| Bottles, vials, jars, demijohns and carboys, molded or pressed dut. | ..... | 14,031 | ..... | 21,649 | ..... | 37,602 | ..... | 43,251 |
| Table and kitchen utensils dut. | ..... | 7,651 | ..... | 17,586 | ..... | 25,306 | ..... | 29,453 |
| Glassware, cut or decorated dut. | ..... | 301,766 | ..... | 195,097 | ..... | 494,392 | ..... | 376,650 |
| Blown glassware, n. e. s.— | | | | | | | | |
| Bottles, ornaments, gauge glasses and other n. e. s. dut. | ..... | 50,320 | ..... | 61,121 | ..... | 114,227 | ..... | 127,845 |
| Bulbs for electric lamps dut. No. | 1,423,459 | 12,974 | 877,722 | 8,839 | 2,587,336 | 24,845 | 2,268,841 | 23,100 |
| Chimneys, globes, shades, prisms and other illuminating glassware dut. | ..... | 66,459 | ..... | 69,689 | ..... | 144,343 | ..... | 131,499 |
| Articles and utensils for chemical, scientific, and experimental purposes dut. | ..... | 38,068 | ..... | 44,619 | ..... | 73,843 | ..... | 87,240 |
| Other glassware dut. | ..... | 105,986 | ..... | 151,266 | ..... | 187,816 | ..... | 248,399 |